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The transatlantic record has again been lowered by the swift Cunarder "Lucania," which reached New York on Sept. 28, having made the run from Daunt's Rock to Sandy Hook lightship in 5 d., 7h., 48 min., thus beating the best previous record by herself on her last trip by 50 minutes. Her average speed was 21.76 knots for the voyage, and her best day's run was 552 knots. Her course was 2,782 miles in length. The vessel's best record for a 24 hours' run (made on a previous voyage) is 560 knots. She had favorable weather all the way across; but it is probable that record-breaking is about over for this season.

The amount of excavation completed on the Chicago Drainage Canal on Sept. 1 was about 13,000,000 cu. yds., of which over 1,300,000 cu. yds. was on the Des Plaines River division. Of this amount nearly 4,000,000 cu. yds. is classed as rock. The work done thus far has cost $5,600,000. Of this total $400,000 worth of work has been done in advance of the time required in the contract, but there is $1,600,000 of work behind, so there is a net deficiency in the rate of working of $1,200,000. It is estimated that the drainage board will have for disposal some 12,000,000 cu. yds. of excavated rock. Various propositions for the advantageous disposal of this material are under consideration, including its sale on a 10% commission and its use for macadamizing roads in Cook county.

Electricity is to be used for lighting the cable cars on the Brooklyn Bridge in place of the present oil lamps. At the last meeting of the Bridge trustees a report on this subject was handed in by Superintendent C. C. Martin, to whom the subject had been submitted. He reported that the Safety Car Heating & Lighting Co. had submitted the following bid: To equip 60 cars complete, with four 4-burner lamps each, or a total of 160 c. p. for each car, for $14,708 including repairs, attendance and interest on equipment, said Mr. Martin, the cost of using Pintsch gas would be 7½ cts. per hour per car; if the bridge operated its own gas plant, it would cost 4.4 cts. per hour per car. The General Electric Co. proposed to equip 60 cars with ten 16-c. p. lamps each, together with engines, dynamos and complete plant, for $14,200, and to guarantee that the operating expenses should not exceed $4,905 per annum. Taking the interest on the first cost of the plant at 5%, or $710; depreciation and repairs at 6%, or $862, and adding these to the operating expenses, gives $6,478 for the total annual cost. This, says Mr. Martin, is equivalent to a cost of 5.3 cts. per hour per car. Another proposition from the Electrical & Mechanical Engineering & Trading Co. was to furnish complete equipment for lighting the cars with electric light, including engines, dynamos, wiring, etc., for the sum of $17,634. The total operating expense for the year would be $3,409.20. Including interest on investment at 5%, depreciation and repairs at 6%, the cost per car per hour for 160 c. p. of light would be 2.78 cts. Each of the bidders will give a satisfactory bond that the operating expenses of car lighting will not exceed the figure given by them respectively. The majority of the trustees voted to adopt electricity. It will require about three months to make the change.

Electricity has been applied to the spinning of rope and cordage by Mr. John Good, of Brooklyn, already well known as the man who revolutionized the manufacture of rope. Until Mr. Good took out his first patent in 1869 rope was made in the ropewalks, much after a fashion that had prevailed for centuries before. Since that time he has taken out about 50 patents for rope-making machines, and they are used all over the world. Mr. Good was born in Ireland in 1844, and was brought to the United States by his widowed mother in 1851. He was early thrown upon his own resources; began to invent and rented, but did not sell, his machines. As a result he is a power in the cordage world and very wealthy.

The dangerous grade crossing of the New York, New Haven & Hartford Railway, at Forest Hills, near Boston, Mass., is to be removed at an ultimate cost of about $3,000,000. The plans involve change of the course of Stony Brook near the station, and the cutting of a new channel about 1,400 ft. long. Another channel, 2,600 ft. long, will have to be cut from Boylston to Hogg bridge.

The armored cruiser "Maine" made a preliminary machinery trial on Sept. 25, and the working of the machinery was pronounced very satisfactory. Under a moderate forced draft the engines made 131 revolutions per minute with a steam pressure of 140 lbs. The estimated speed was 17 knots, on a 30-mile run out and back from Sandy Hook. The "Maine" is 318 ft. long, 57 ft. beam, 21½ ft. draft, 6,648 tons displacement and her contract horse-power is 9,000. The engines are of the twin-screw, vertical, triple-expansion type, and the contract speed is 17 knots. The "Maine" was built at the U. S. Navy Yard, at Brooklyn; work being authorized Aug. 3, 1886, and the cost limit was $2,500,000.

Plans for the elevation of the Chicago & Northwestern R. R. tracks between Sacramento Ave. and 40th St. in Chicago have been prepared by the company's officers and work will begin as soon as an enabling ordinance is passed by the city. The work is expected to occupy about 18 months. The tracks will be raised about 8 ft. above their present level and the streets will be depressed 8 ft. as a maximum.

The most serious railway accident of the week was the derailment of a freight train near Woodstock, Ill., on the Chicago & Northwestern Ry., Sept. 30, in which five persons were killed.——Another serious accident was a derailment, Sept. 30, near Maumee, O., on the Wabash R. R., in which the engineman and fireman were killed. A switch leading to a sidetrack had been opened by train wreckers, and the train was going too fast to take the turnout curve. The engine was upset and the men were crushed under it.——A third accident, fortunately unattended by loss of life, occurred at Lafayette, Ind., Sept. 27. Nineteen freight cars at the rear end of a freight train broke away on the heavy grade out from the city and ran back to the Union station, where a passenger train was standing. The yardmaster heard the cars coming and was in time to switch them onto a track at the east side of the station, where they ran over an earth bank used as a buffer stop, crossed the street and broke down the wall of a building. A number of the cars were smashed and piled up in the yard. The cars carried away part of the east side of the station, and a tank car entered the waiting room. A serious accident at the same place, caused by a passenger train running away while coming down the same grade, was reported in our issues of May 11 and 25, 1893.

The Illinois Central R. R. bridge over the Iowa River at Iowa Falls, Ia., was burned Sept. 28.

The outward bound oil tank steamer "Allegheny" was run into and sunk by the inward bound steamer "Caucase" in Delaware Bay, Oct. 1. Some of the tanks were burst by the collision and the oil caught fire, so that the rescue of the crew was accomplished with great difficulty.

The wrecked water tank at Salem, S. D. (see Eng. News, Aug. 9, 1894), has been rebuilt. The dimensions of the new tank are the same as those of the old, 16 × 24 ft. × 25 ft. high, and it is supported on the same style of tower except that the floor timbers are heavier. The present timbering consists of four 12 × 12-in. pieces, 6 ft. c. to c., with 3 × 12-in. pieces, 10 ins. c. to c., between, the whole thoroughly bridged and braced. The old tower failed because of the weakness of the floor timbers, which were 2 × 14-in. joists, 12 ins. c. to c., doubled beneath the center of the tank. We are indebted to Mr. M. A. Blackburn, of Salem, for the above information.

The 4,100-ft. cast iron intake pipe for the Cooperstown, N. Y., water-works has been completed by the contractor, Mr. Joseph G. Falcon, and work is now in progress taking up the old 10-in. cast iron intake pipe. The new pipe is of ⅝-in. cast iron, 14 ins. in diameter, and runs from a dam on the Susquehanna River, in that stream to the outlet of Otsego Lake, a distance of 2,700 ft., and thence 1,400 ft. out into the lake, where it ends in a cylindrical strainer placed about 5 ft. above the lake bottom. In the lake portion of the pipe 64 Falcon flexible ball joints were used, these being placed every five lengths and bolted by a diver at the lake bottom. The pipe was tested with 40 lbs. pressure; the gage fell almost imperceptibly to 20 lbs., where it remained until the test was completed. The depth of water in the lake at the outer end of the intake was 40 ft. The pipe was furnished by R. D. Wood & Co., of Philadelphia. Mr. J. Warren Lamb is Superintendent of the Cooperstown Water Co.

Fiber conduit for sewer work at Charleston, S. C., was called for in specifications for some recent work in that city. Mr. R. Frank Hartford, of Atlanta, Ga., who drew the specifications, informs us that the Charleston soil, especially in the outlying districts bordering on the salt marshes, causes rapid deterioration in cast iron pipe. Some experiments with pipe manufactured by the Fiber Conduit Co., of Orangeburgh, N. Y., promised so well that Mr. Hartford decided to put some of it to the test of actual use. Only a small amount of the pipe will be used, however, probably not over 40 ft., and that for an inverted siphon. Mr. Hartford thinks the pipe admirably adapted for sewer work where the pressure will not exceed 10 lbs. and neither steam nor water at high temperatures will reach it. The experimental tests were designed to determine the amount of absorption of the pipe and its acid-resisting qualities.

The proposed Lake Erie-Ohio River ship canal is being vigorously boomed by the Pittsburg Chamber of Commerce. A provisional committee has been appointed to take charge of the scheme and includes such men as C. L. Magee, ex-Governor A. B. Fleming, of West Virginia; H. C. Frick and B. F. Jones, the Pittsburg iron and steel manufacturers. Engineers and members of the committee have started over the three routes proposed to gather material upon which contractors may estimate the cost. The three routes are from Erie to Pittsburg, from Cleveland to Marietta and from Toledo to Cincinnati. Under the late river and harbor bill, the Secretary of War will also have a survey made by the army engineers, and will report to the next Congress.

The Canadian ship canal at Sault Ste. Marie was opened by admitting water into it on Sept. 24, and it is expected that it will be ready for navigation within a month. This canal, commenced May 1, 1889, is 3,700 ft. long and 21 ft. deep, and has one lift of 18¾ ft. The amount appropriated for the work was $4,000,000. It is similar in design to the United States ship canal now under construction on the American side of the river. The Canadian lock is 900 ft. long, from gate to gate, and 60 ft. wide. Around the gates the walls are 25 ft. thick, and the remaining walls are 20 ft. thick at the bottom and 11 ft. thick at the top. There will be 21 ft. of water over the miter sill. The filling and emptying are done through 152 openings in the lock floor leading to four culverts beneath the floor. At the eastern end are three sets of gates; one to be used for emptying the lock for repairs, etc., and another for use in case of accident. At the upper end of the lock are one main and a guard gate. These gates will be operated by electric power.

The designs for the Atlanta exposition buildings prepared by Mr. Bradford L. Gilbert, of New York city, have been accepted by the management, and he will be the architect of the Manufactures, Mining, Machinery, Electricity and Agricultural buildings. Mr. W. T. Downing, of Atlanta, will be the architect of the Administration building. The Manufactures building will be 216 × 370 ft., and the other buildings are in proportion. The exposition is to be held in the fall of 1895.

On Oct. 26 the people of the city of Duluth will vote on the purchase of the water plant of the Duluth Gas & Water Co., for $2,106,000, at which figure the company has offered to sell the plant. On the same date there will be a vote on issuing $600,000 in bonds to improve the present plant, if bought, and also on issuing bonds for an independent city plant.

MACHINERY FOR OPERATING A 247-FT. SWING SPAN BY A PELTON WHEEL.

(With inset.)

We illustrate on our inset sheet this week full details of the machinery for operating a 247-ft. swing bridge by a Pelton water-wheel. This is, so far as we know, the first application of a water motor for this purpose, and the details of the mechanism are, therefore, of especial interest, although the span is quite unimportant in length and weight, compared with several other recently-constructed swing bridges. The bridge crosses the Naches River on the line of the Southern Pacific R. R. near Beaumont, Texas, and the idea of using the water motor was suggested by the proximity of a water-works stand-pipe, from which water, under a head of about 80 ft., could be secured. It was decided, therefore, to convey the water from this stand-pipe along the bed of the river to the center pier, and thence to a Pelton water motor, which, after investigation, the railway officials concluded to be the best adapted to this particular purpose on account of its simple design. The bridge has now been in operation for some time and it is stated that the machinery has been found very efficient and satisfactory.

Only the details of the operating machinery and the construction of the turn-table are shown in the drawings, as there are no especially novel features in the design of the trusses. Briefly, the bridge has a span of 247 ft. and carries a single railway track, the distance between centers of trusses being 17 ft. The turn-table is rim-bearing and is shown in detail in Fig. 1. The center pier is a steel cylinder, filled with concrete and capped with a layer of Portland cement, on which the track for the drum is laid. To secure a perfectly even and level bearing for this track, a layer of iron cement was placed between the track segments and the masonry. This iron cement was composed of sal ammoniac, sulphur and iron borings, in proportions of 2 to 1 to 200 by weight, and made into a paste with water. As will be noticed from the drawing, a layer of the same cement is placed between the upper track segments and the lower flange of the drum. It will also be seen that the drum is provided with a hand-turning apparatus, for use in case of the failure of the power mechanism. The general details of construction are clearly shown by the drawing, and call for no special mention.

Turning now to the operating mechanism, Fig. 2 shows a general sketch plan of the arrangement of the Pelton motor and the spur gearing used. The pipe from the stand-pipe runs in a recess, or trough, in the top of the pier to the east center bearing. It passes up through this and thence makes a right angle turn to the motor, located outside of the left-hand truss. As, of course, that part of the pipe above the pivot casting turns with the bridge, a brass stuffing box connection is made to allow of the movement. Through a connection, provided with the necessary valves for cutting off and throttling the flow, the water enters the chamber of the 24-in. Pelton motor. The construction and operation of the Pelton wheel is well known and needs no special description here. To carry off the water discharged from the motor, a waste pipe is connected to the hole in the sole plate and discharges into an annular trough, carried part way around the pier. This in turn discharges into a short trough leading over the edge of the pier.

In Fig. 2 the chain of spur gearing from the motor shaft to the turning shaft is shown in diagram only. Fig. 3 shows the same gearing more in detail. As will be noticed, a rather large number of spur gears had to be used to arrive at the required reduction of speed from the motor shaft, but this was considered preferable to using worm gearing. This train of gears can be very easily followed from the drawing. The speed of the motor shaft is 342 revolutions per minute, and that of the turning shaft is 4.1 turns per minute. When running at full speed the motor develops about 8 HP. The dimensions and speed of the several pinions and spurs are given on the drawing, and the other details of the levers and clutches are also clearly shown. As will be noticed, the levers for controlling the water and those operating the end lifts and turning gears are placed conveniently near each other so that there will be no excuse for the operator throwing the bevel gears in or out before shutting off the water, and thus endangering the breaking of cogs. A complete indicating apparatus (Fig. 1) for recording the motion of the end locks is provided for the guidance of the operator. Details of the end locks are shown in Fig. 4. With a half-head of water and the motor making 75 revolutions per minute, we understand that the ends have been unlocked in 21 seconds and the span has been swung full open in 1 minute and 51 seconds.

In conclusion, it should be stated that the operating machinery was designed by the engineers of the Phoenix Bridge Co., of Phoenixville, Pa., the contractors for the bridge, at the suggestion of Mr. Julius Kruttschnitt, General Manager of the Atlantic System, Southern Pacific Co. The motor was furnished by the Pelton Water Wheel Co., of New York and San Francisco. We are indebted to Mr. John Sterling Deans, M. Am. Soc. C. E., Chief Engineer of the Phoenix Bridge Co., for the drawings and information from which this article has been prepared.

THE EXPERTS' REPORT ON THE PEORIA STAND-PIPE FAILURE.

The engineers of the Pittsburg Testing Laboratory, who were appointed to examine into the Peoria stand-pipe failure and to make such tests as were necessary to determine, if possible, the cause of the failure, have just made their report to Mr. Jacob A. Harman. In view of the various theories which have been advanced to account for this failure, the results obtained by these tests are unusually interesting, and we abstract the main features of the report quite fully. The particulars of the Peoria stand-pipe failure were given in our issue of April 5, 1894, and in succeeding issues we published the specifications for the work and full details of the construction.

The examinations were carried out for the Pittsburg Testing Laboratory by Mr. A. B. Bellows, of Pittsburg, and Mr. T. L. Condron, of Chicago, and were designed to include the stand-pipe at present standing, as well as the one which failed. Owing, however, to the stand-pipe now standing being filled with water, no examination could be made of the inside. Neither could any information regarding the history of the material or the methods of erection be obtained from the Porter Mfg. Co., of Syracuse, N. Y., which built both stand-pipes. The report states, however, that undoubtedly both stand-pipes were built of the same material and in the same manner, since the chemical tests made on the iron from both pipes agree very closely. Several test pieces were cut from the pipe which failed, as follows: One longitudinal and one transverse from the bottom course, ¾-in. plate; one longitudinal from the fifth course, ⅝-in. plate; one longitudinal and one transverse from the seventh course, 9-16-in.

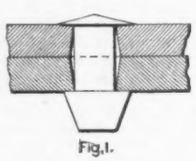


Fig. 1.

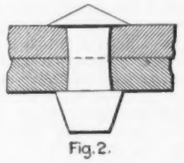


Fig. 2.

plate, and one longitudinal from the thirteenth course, ⅜-in. plate. The results of the chemical and physical tests of these six test pieces are shown in the accompanying table.

Results of Tests Made on Steel Plates Taken from Stand-pipe at Peoria, Ill., Which Failed March 30, 1894.

No. of course...	—Bottom.—		5th.	13th.	7th.	7th.
Test piece cut..	Trans.	Long.	Long.	Long.	Trans	Long.
Thickness, in ..	¾	¾	¾	⅜	9-16	9-16
Carbon, %	....	0.11	0.1	0.13	....	0.12
Manganese, %...	....	0.61	0.39	0.59	....	0.5
Phosphorus, %..	....	0.123	0.139	0.155	....	0.132
Sulphur, %.....	....	0.117	0.08	0.053	....	0.071
*Original area...	1.157	1.143	0.938	0.586	0.855	0.868
Area after fracture, sq. in....	0.867	0.813	0.734	0.404	0.428	0.623
**Elastic limit ..	49,000	48,120	41,580	50,340	40,940	47,240
**Tensile str'gth	61,360	59,490	62,900	67,140	61,760	63,480
Elong. in 8 ins,%	16.25	15.	17.75	14.25	23.75	20.
Reduc. of area,%	25.07	28.88	21.75	31.06	49.94	28.23
Character of fracture	——Laminated and dull.——					
Cold bending test ..	Broke at: 90°		90°	120°	—Bent, 180° flat.—	

* Sq. ins. ** Lbs. per sq. in.

The examination of the surface of the plates on the inside showed them to be in fair condition, although in places they were somewhat pitted. The report continues as follows:

The most striking fact in connection with the destroyed stand-pipe is the deplorable workmanship. The majority of the rivets in those portions of the pipe which appear to have been least affected by the fall became decidedly loose after receiving two or three sharp blows with an ordinary rivet inspector's hammer. The explanation of this was clearly shown on all portions of the pipe which were broken through the rivet holes. The general appearance of these broken joints is as shown in Fig. 1. You will see from the sketch that at the point where the two plates are in contact, there is about 1-16 in. space, which is wholly unfilled by the rivet. We also notice that the "made" heads of the rivets are frequently only ¼ in. high, many being found which were barely ⅛ in. high, the edge tapering to leaflike thinness. This clearly demonstrates the fact that there was not sufficient stock in the rivets to fill the hole, nor to give satisfactory heads. The importance of the bearing of this point on the East Bluff tower will be shown later.

We note a portion of the specifications, as given in the Engineering News of April 5, 1894, as follows: "Lay out all holes carefully and accurately and punch with a center punch, sharp and in perfect order, from the surface to be in contact, and so that the bevel of the hole may be away from the surface in contact." You will, therefore, see that the specifications were not followed; that these plates, as shown by Fig. 1, were punched from the wrong side. The section of a rivet hole should appear as in Fig. 2. In Fig. 1 the tendency of the rivet headed up is to separate the plates, while in Fig. 2 the tendency is for the rivet to act more as a counter-sunk rivet, and the better it fills the holes the tighter will the plates be held together. The clearance between the punch and the die has been excessive, being ⅛ in. instead of 1-16 in., which is the best practice. From the general appearance of all breaks, and from the fact that there were a large number of cracks running from the rivet holes to the edges of the plates, which cracks branched in every direction, it is evident that the steel was exceedingly brittle and probably non-homogeneous.

The report then continues by stating that the tests and analyses leave but little doubt that had the plates used in the pipe been properly tested in the mill they would all have been rejected, on either the physical or chemical test. The fractures were in all cases more or less laminated and dead looking. In structures of this kind the report states that the phosphorus should be kept within the 0.08% limit and the material should be capable of bending 180° flat upon itself, without showing sign of rupture on the convex side.

The report states that an examination was then made of the East Bluff tower, now standing, and that here the workmanship seemed to be fully as bad as on the other tower. Some of the rivet heads were noticed to have been calked, and, upon scraping away the coating, drops of moisture appeared, showing that the rivets did not fill the holes. The heads of the rivets were also found to be thin, as in the other pipe.

For the purpose of making chemical tests chips were taken off the edges of several of the lower plates with a sharp chisel. The tests of these chips showed the following results:

No. of specimen.....	1	2	3	4
Carbon 0.1%	0.1%	0.12%	0.13%	
Manganese 0.11%	0.47%	0.66%	0.51%	
Phosphorus 0.114%	0.138%	0.116%	0.144%	
Sulphur 0.128%	0.4%	0.088%	0.142%	

The report then continues as follows:

The phosphorus runs from 0.114% to 0.144% and the sulphur from 0.04% to 0.142%, showing that the material is high phosphorus steel, brittle and treacherous. The hardness and brittleness of the steel were very noticeable in taking the chippings, as continuous cuttings could not be made. The chips broke off generally after they had attained a length of ¼ in., while in good soft steel no such thing should occur. The chippings taken show the material in the bottom courses of the standing tower to be of the same grade and quality as the tower which failed. . . . From the specifications, as given in the Engineering News, it immediately strikes one that the make of steel is not designated; that no mention is made of any required elongation, reduction of area or elastic limit, and that neither is there any limit placed on the phosphorus or sulphur. The requirement that the plates must be "sufficiently ductile to admit of rolling while cold around a radius of 20 ins., without developing flaws," etc., is absolutely worthless, as, for work of this character, the steel should bend 180° flat upon itself without showing cracks upon the convex side. The steel cut from the pipe that failed broke while bending from 90° to 180°, except in two cases, and these showed cracks on the convex side, yet this steel would easily bend cold to a radius of 20 ins.

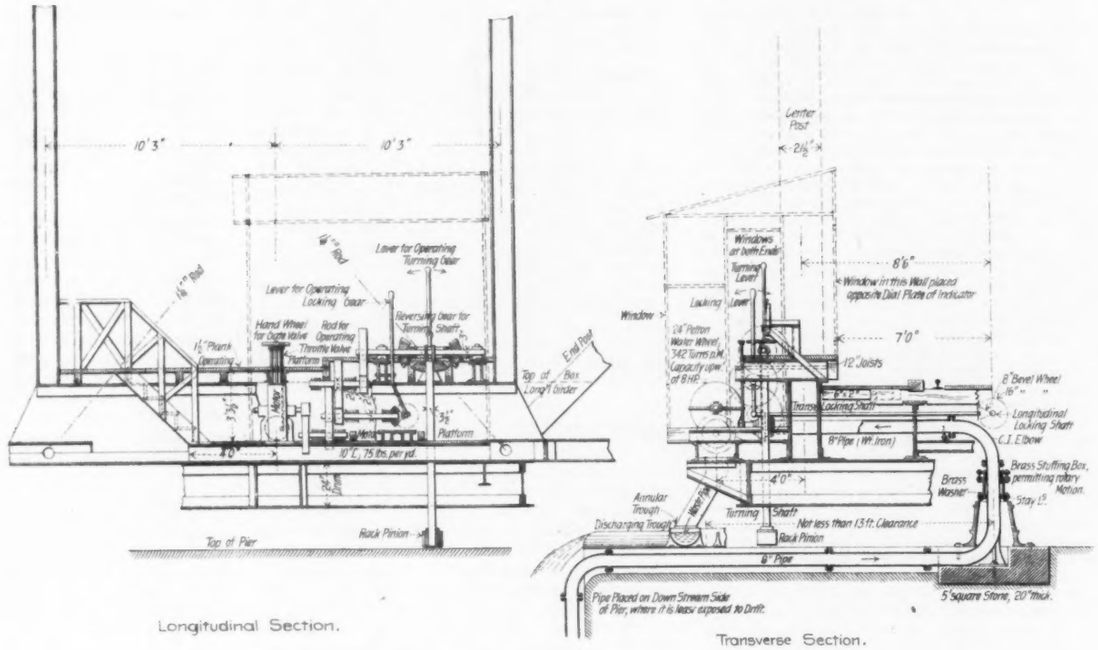


Fig. 2. General Plan of Operating Machinery.

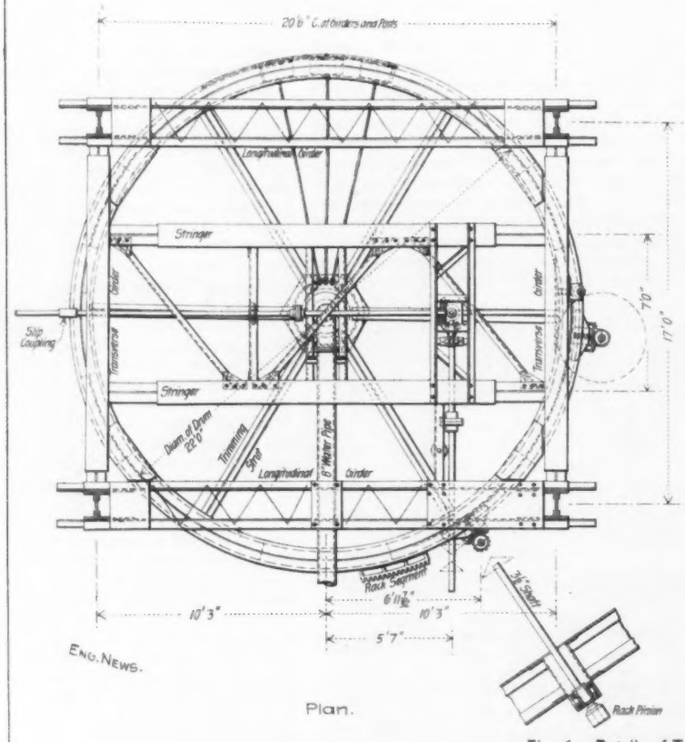


Fig. 1. Details of Turn Table.

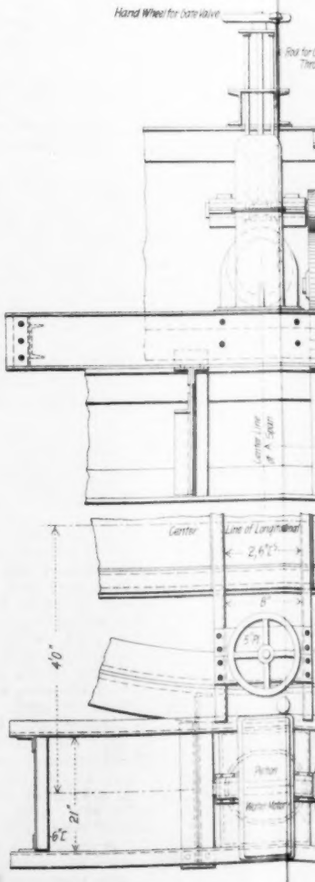


Fig. 3.

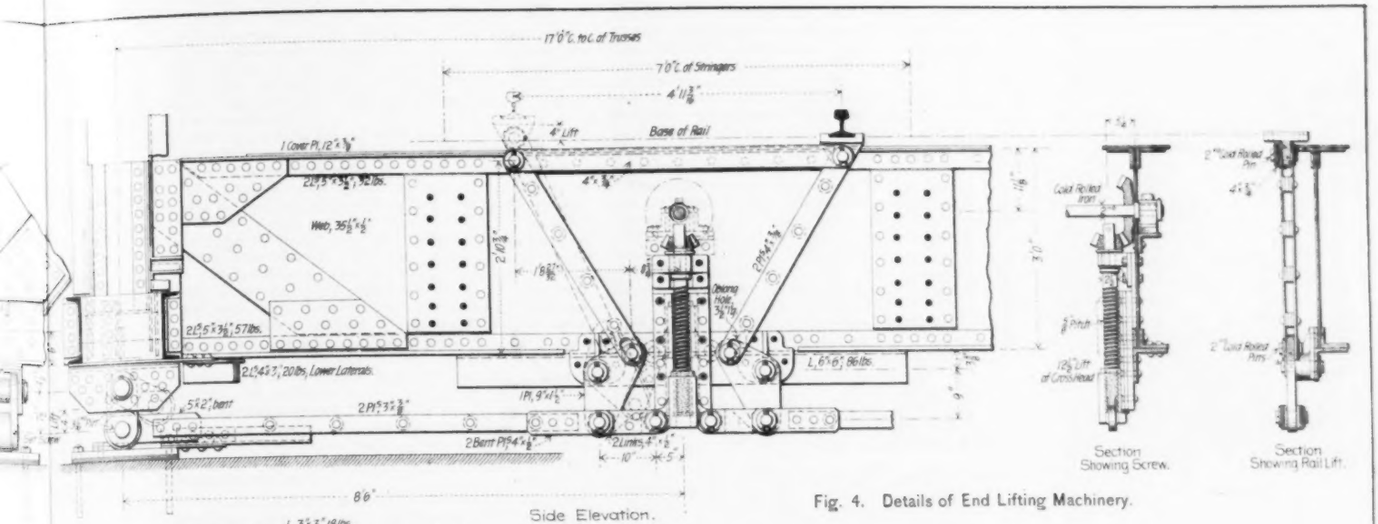
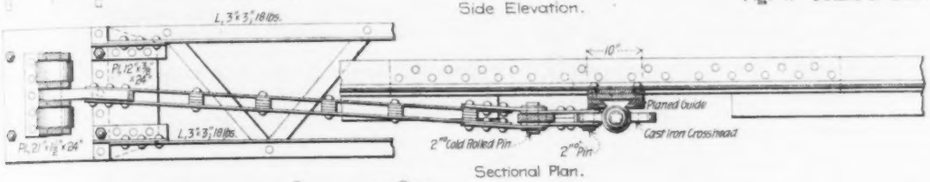
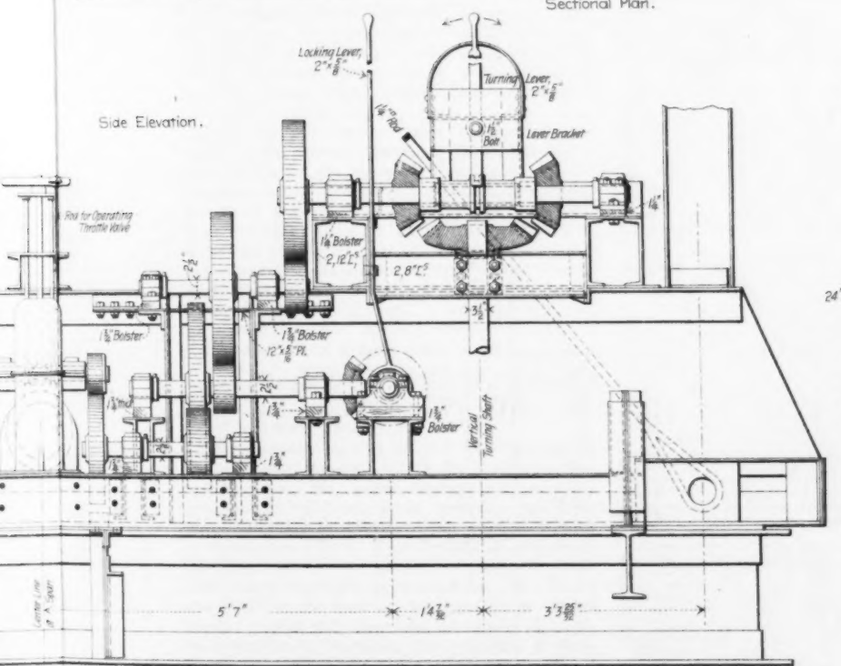
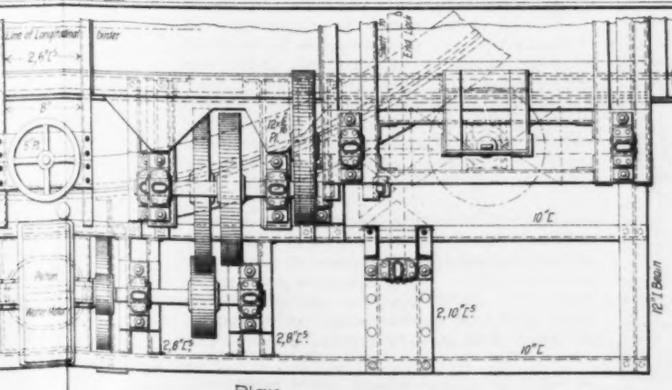


Fig. 4. Details of End Lifting Machinery.







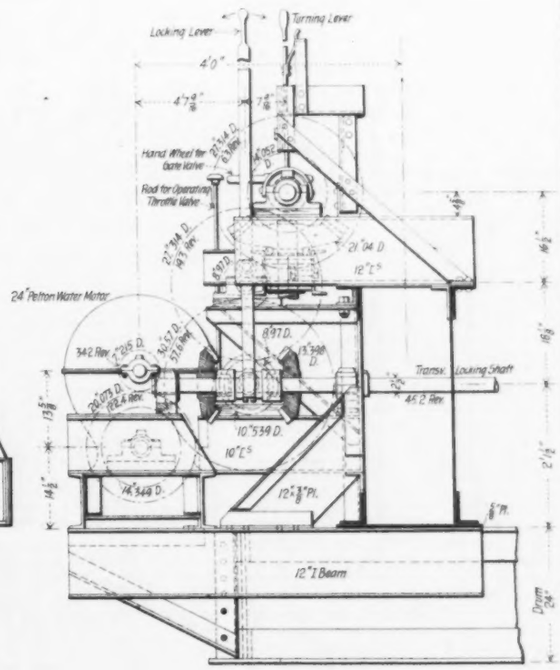


Fig. 3. Enlarged Details of Operating Machinery.

MACHINERY FOR OPERATING A 240 FT. SWING BRIDGE BY A PELTON WATER WHEEL.

NECHES RIVER BRIDGE, SOUTHERN PACIFIC R. R.

Julius Kruttschnitt, General Manager
Atlantic System, Southern Pacific Co.
Phoenix Bridge Co., Phoenixville, Pa., Contractors,

CHAS. HART & SONS, LITH., 26 VESEY ST., N. Y.

The bottom course in the tower now standing measures ⅝ in. in thickness. With an allowable stress of 9,000 lbs. per sq. in., the thickness of this bottom course should have been ¾ in. The rivet-spacing appears to be all right, based on the data at hand, and the tower is approximately plumb. The foundations and anchorage seem to be of first-class quality and in good condition.

The theory is advanced by Professor Pence that the expanding and contracting of the water in the rivet holes, not properly filled by the rivets, developed cracks, which caused the failure of the pipe. This theory, in view of what has already been found as to the quality of the metal and the condition of the rivet holes, seems altogether plausible. The rivet holes show no signs of having been reamed, and it is a well-known fact that in high phosphorus steel the metal around the hole is injured and an infinite number of cracks started which need only slight assistance to cause larger cracks and probable rupture. There is no doubt but that the tower now standing is made of just as poor material as the one which failed; that the workmanship is just as bad—in short, that it is dangerous, treacherous and a menace to life and property in the immediate vicinity. We most decidedly advise that this tower be taken down as soon as possible, as there is no manner of strengthening such a structure, which is rotten to the core, and because, as the winter approaches, the danger of failure is greatly increased.

We are indebted to Mr. Jacob A. Harman, City Engineer of Peoria, Ill., for the copy of the report from which the above abstract has been made.

ARE IRON AND STEEL CRYSTALLIZED BY VIBRATION?

A paper by Mr. T. A. Rickard on the "Limitations of the Gold Stamp-mill," read a year ago before that section of the International Engineering Congress in charge of the American Institute of Mining Engineers, and published in its Transactions, vol. XXIII., p. 137, has given rise to a lively discussion in the Society upon the effects of vibration upon the molecular structure of the stamp-stem and upon iron and steel generally.

In Mr. Rickard's original paper the statement was made that the vibration caused by the stamps gradually crystallized the ironwork of the mill. In the discussion which took place at Chicago, Mr. Philip Argall, of Denver, in referring to this statement, remarked that "vibration under all conditions will crystallize iron." Dr. R. W. Raymond criticised this statement, characterizing it as being "beyond question incorrect," and quoted the investigation in Howe ("Metallurgy of Steel," p. 196) in support of his statement. Mr. Howe's conclusion, after a patient analysis of a great mass of evidence, was:

> To sum up: While vibration and shock often cause rupture under light stress, and while it is proverbially difficult to prove a negative, we have, I think, every reason to believe that the granulation and crystallization of iron under vibration is a myth.

The discussion on this subject was resumed at the Bridgeport meeting of the Society during the current week. Mr. Argall claimed that vibration, accompanied by heat, would certainly crystallize iron, and quoted in support of this position Bloxam & Huntington and A. F. Hill. He also declared his belief that intense vibration, under any conditions, would eventually crystallize iron. His theory was based on the admitted fact that the molecules were in motion, and, therefore, he claimed that any force capable of increasing the amplitude of their vibrations might induce a change of structure; just as in electrolysis an electric current directed the movement of molecules in the electrolyte to form new bodies. Mr. Argall quoted Barus, Fairbairn, Rankine, Kirkaldy and others in support of his conclusions; though their statements on this head are not very conclusive or explicit. He said that stamp-stems invariably break with a crystalline structure and that it was generally admitted that railway axles were, on the whole, inclined to break with a similar fracture.

Dr. R. W. Raymond, of New York, replied to Mr. Argall, and as his remarks form a valuable summary of the evidence on this important question, we give them practically in full. In this connection we may refer also to a paper by Mr. Paul Kreuzpointner, of the Pennsylvania R. R. testing laboratory at Altoona, abstracted in our issue of July 19, 1894:

> The subject of Mr. Argall's reply to my former remarks is so important as to justify the most extended discussion. And I would not deny that, as a part of such discussion, the citation of authorities is pertinent and valuable, although the mere heaping up of contradictory statements and opinions is not likely to determine the truth, without such further sifting and weighing of the evidence as will show what may be taken as thus far reasonably proved. I wish to recall here only the fact that I disclaimed any narrow sense of the term "crystallized," and accepted, as the subject really under discussion, the question, whether there is really a molecular change produced by vibration in iron or steel.
>
> The fracture of a stamp-stem is a fact; the notion that it is due to a molecular change caused by vibration is a theory. Nobody denies that this is conceivably a true theory; but a good many observers have been led to doubt it, because there is not a single clear experimental proof of it, and because attempts to prove it by careful experiment have proved the contrary, so far as they have had any definite result whatever. It is quite out of place for the defenders of the theory to characterize as dogmatic theorists those who have no theory at all, but are simply asking for the facts. Dr. John Percy said in 1864:[*]
>
> Another point remains to be considered, namely, whether vibration caused by impact, or otherwise, may induce a crystalline arrangement which did not previously exist, or was only imperfectly developed. I have not met with any evidence to justify an answer in the affirmative.
>
> This is not abstract theory but practical common sense, as is also the observation which follows:
>
> Neglect in observing the essential connection between the character of the fracture and the particular mode in which it has been effected, has led to the conclusion that the crystallization of iron has originated from mechanical treatment, when, in reality, crystalline structure pre-existed, and was only rendered easily manifest by fracture consequent on induced brittleness.[1]
>
> This declaration of Percy's represents correctly, I think, the conclusion to which any competent observer, critically examining the evidence accessible in 1864, would have been led. That the situation has not been changed in favor of the vibration-theory by any subsequent evidence, will appear in the following passage, translated from the handbook of Prof. A. Ledebur,[2] who may fairly be called the highest, as well as the latest authority on iron and steel:
>
> The observation has been often reported, particularly in former times, that iron exposed to continuous shocks, as in railway axles, crane chains, etc., suffered a loss of strength and toughness as the result of a change in its structure; especially, that fibrous tough iron was in this way gradually altered to granular brittle iron, and that in this process could be found the cause of the occurrence of fracture in pieces which had served their purpose for decades without breaking. According to this view, continued shocks (anhaltende Erschuetterungen) would produce the same effect as . . . heating wrought iron nearly to melting point and gradually cooling it.
>
> This supposed observation received a seeming confirmation from the law announced by Woehler, in 1870,[3] as the result of thorough experiments, according to which the fracture of a body might be brought about by numerous repeated strains, no one of which reached the breaking limit. Later experiments[4] have shown that fracture is not induced, even by an unlimited number of strains, if a certain limit of strain is not exceeded.
>
> But the opinion that a fracture caused by repeated strains is the result of a change in structure, and particularly that fibrous wrought iron is transformed into granular under continuous shocks, has proved to be entirely erroneous (vollstaendig irrig). On page 642 the circumstance has been pointed out that the appearance of the fracture of fibrous iron is dependent upon the manner of the breaking, and that fibrous iron shows a complete coarsely-granular fracture when suddenly broken by a heavy blow. Such a shock is usually the cause of the fractures in which it has been believed that the transformation of fibrous into granular iron was observed.
>
> Bauschinger, in 1878, took links from a chain bridge erected in 1829 at Hamburg, and subjected in service to continual shocks (Erschuetterungen), and compared them with similar links of the same material which had remained in stock unused. (Here follows a table of tests.) The fracture of the broken pieces showed no change due to use; the pieces which had been in service showed to a large extent fibrous structure.[5]
>
> The wrought iron bolts of a wooden railway bridge on the Allgau road, having been tested for strength before use, showed, when tested again by Bauschinger after 25 years, no diminution in strength. (Here follow the figures.) Again, a comparative test made by Beilelubsky, in 1888, between the links of the Kiew chain bridge, which had been 40 years in service, and the links of the same material which had remained in stock, indicated no change in these properties. All the test pieces showed fibrous structure.[6] Numerous experiments instituted by Bauschinger in the mechanico-technical laboratory of the Technische Hochschule, at Munich, in which bars of iron and steel were submitted to repeated shocks, led him to the conclusion that "Strains of iron and steel repeated frequently, millions of times, bring about no change of structure."

[*] "Metallurgy," "Iron and Steel," p. 12.

[1] Dr. Percy cites, in this connection, Kirkaldy's book, and says: "The author appears to have arrived at nearly the same conclusion as myself."

[2] "Handbuch der Eisenhuettenkunde," part III., "Malleable Iron," Leipzig, 1894, p. 689.

[3] "Zeitschr. f. Bauwesen," vol. XX., p. 83.

[4] Spangenberg in the same journal, vol. XXV., and Bauschinger, in "Mitth. aus dem Mech.-Tech. Lab. in Muenchen," Heft 13.

[5] The original, "Die benutzten Glieder zeigten zum grossen Theil sehniges Gefuege," is ambiguous. It may mean that many of the pieces showed fibrous structure, or that all of them showed a predominantly fibrous structure. But it is clear that they were not characteristically granular, and the preceding statement that there was no recognizable difference between them and the unused pieces is unequivocal.—R. W. R.

[6] "Stahl und Eisen," 1889, p. 917.

The word "Erschuetterungen," which I have translated "shocks" in the foregoing extract, is a stronger term than "Schwingungen" (vibrations). It includes both shock and vibration, and exactly represents Mr. Argall's definition, "vibration attended with sharp blows." Professor Ledebur's conclusions are, therefore, directly contradictory of Mr. Argall's view.

Mr. Argall replies to my statement that "it is not even settled that vibration will crystallize iron under any conditions," by asserting his belief that "it is a settled and undisputed fact that vibration in the presence of heat will crystallize iron." He is, of course, aware that I was speaking of cold metal only; and I do not care to be drawn away from the issue which he has himself taken pains to confine to the conditions obtaining in stamp-mills. Nevertheless I may venture to say that the authorities he cites do not warrant his sweeping conclusion: "We see, then, that vibration of heated bars will induce crystallization and consequent change of structure." The really "settled and undisputed fact" is that heat-treatment alone, without any vibration, will produce the change referred to, as Professor Ledebur, in the passage I have quoted, incidentally points out. All that has been suggested as to vibration is that it facilitates the work of heat. The essential agent must still be the heat, for the simple reason that heat alone will do the work, whereas vibration alone, so far as we can find out experimentally, will not. At the very best, Mr. Argall's assertion that heat and vibration will produce a certain result is no contradiction of my assertion that it is not settled that vibration will do it.

Moreover, there is no argument to be drawn by analogy from the behavior of iron under special heat-treatment to its behavior at ordinary temperature and after complete solidification. The very term vibration means different things in the two cases. Shock is differently transmitted in a heated bar, and structure is unquestionably under incipient obliteration. Mr. Argall's statement, "We have seen that vibration of hot iron bars induces crystallization at temperatures far below plasticity," is not warranted, even in its vagueness. The only temperature he specifies is 900° F. (482° C.), which is not "far below plasticity." This temperature is, in fact, almost exactly the point at which iron exhibits a remarkable and sudden change in physical qualities, indicative of a weakening of structure. The tensile strength and elongation, as determined by Kollman [7] for the temperatures below and near this point, are as follows:

Deg. C.	Tensile strength, kilo. per sq. mm.	Elong., p. c.
310	33.5	33.0
340	32.1	35.0
410	27.0	45.0
510	11.1	37.0

It will be seen that, between 410° and 510°, the strength has diminished more than one-half, and the elongation has passed its maximum. In a word, what I suppose Mr. Argall means by "plasticity," has clearly set in.

Mr. Argall says that he is not aware that any law of physics or of the molecular theory of matter would be violated by the assumed rearrangement of molecules in a viscous solid, such as iron, at ordinary temperatures. For my part, I am not aware of such a fact either. If there were any known law thus violated, the assumption would, of course, have to give way to the law. But the arguments and citations by which Mr. Argall seeks (as I suppose, for I cannot conceive on what other ground he considers them pertinent) to render his assumption theoretically probable, fall far short of that effect; while the effect itself, if achieved, would amount to nothing. For Mr. Argall and his molecular argument are confronted by practical men, not theorists; and when he says, "Why should not this be possible?" they may reply, "We don't know; all we know is, that the thing, possible or not, has not been proved to occur." Mr. Argall seems to dislike my term "fable," and Mr. Howe's term "myth," as applied to his theory. If he prefers Professor Ledebur's term, "entirely erroneous," he is welcome to that. I beg to observe, however, that a fable, as I understand the term, is not necessarily an impossible, but simply an untrue story—in this case, a product of the "scientific imagination." But what does the theoretical argument of Mr. Argall really prove?

1. Barus, he says, has shown that "the chemical equilibrium of a solid changes with each change of strain." Dr. Barus, in the paragraph quoted, refers not to vibration at all, but to steady pressure; and not to molecular or physical equilibrium, but to chemical equilibrium. And his conception of chemical equilibrium is measured simply by electrical resistance. Moreover, his experimental basis was a non-fibrous solid, namely, glass.

2. Mr. Argall's second quotation from Barus asserts a change in the molecular configuration of cold glass-hard steel, produced by time alone. This change is in hardness—not necessarily in structure. But here,

[7] Cited by Ledebur, p. 691.

also, it will be observed, we have a non-fibrous material, and one which is already under intense internal strains. All that Dr. Barus has proved is, that these strains, existing between molecule and molecule, readjust themselves at ordinary temperatures, in the course of years, almost as much as they would do at 100° C. in the course of a few hours. There is no tangible necessity here for a change in "molecular configuration," even; but, besides that, I do not understand that Dr. Barus means by "molecular configuration" molecular arrangement, or what we call structure.

3. Mr. Argall quotes from Dr. Barus the statement that Osmond claims, "that strain more or less completely converts cold metals from one definite molecular condition into another." I may be permitted to quote, in addition, the remark of Dr. Barus, which immediately follows:

> I have been unable to find, however, that Osmond has any direct evidence to support this assertion, and I have already pointed out some of the difficulties which Osmond must surmount before his view can gain general credence.

This shows pretty plainly where Dr. Barus stands on the question here under discussion. It is evident that he does not draw from his own experiments on glass and glass-hard steel inferences favorable to Mr. Argall's theory of stamp-stem crystallization. But M. Osmond is an observer of recognized acuteness and authority; if he has really asserted the general proposition, apparently attributed to him by Dr. Barus, his assertion of it has weight, whether Dr. Barus agrees with it or not; and that weight bears unquestionably in favor of Mr. Argall's theory, though the term "strain" may or may not designate the particular kind of strain to which Mr. Argall ascribes a particular kind of molecular change.

I have, therefore, examined with care the statement of M. Osmond; and I find that he speaks exclusively of the two varieties of iron (alpha and beta iron) which he considers as two "molecular conditions"—not two different arrangements of the molecules—and of which he says: [1]

> The alpha variety (malleable) predominates in steels slowly cooled from red heat, and the more exclusively, as these metals approach more nearly pure iron.
>
> The beta variety (hard and brittle) is formed:
>
> (a) Artificially, by the action of any mechanical pressure applied below very dark red heat and producing permanent deformation.
>
> (b) Spontaneously, at a certain critical temperature not yet determined.

Clearly enough M. Osmond is announcing no general law, but explaining (upon his own alpha-beta theory, not by any means universally accepted as yet) the familiar effects of cold-rolling and hammering upon iron and steel. He carefully excludes strains which do not produce permanent deformation, and thus implicitly contradicts Mr. Argall's hypothesis.

4. The researches upon "hysteresis," concerning which Mr. Argall quotes Dr. Barus' reference to Warburg, Ewing, Rowland and Bell, are too abstruse and too little pertinent to repay special analysis and discussion here. If they proved anything for his purpose, they would prove too much. The kind of molecular change which these writers call "hysteresis" is something which they can produce by magnetism as well as by mechanical force; it is evidenced by electrical resistance wholly or chiefly; it is not shown or asserted or believed to produce a granular structure out of a fibrous one; and it is only called a molecular change because, on the molecular theory of matter, the molecules must be somehow concerned in it. Pure and simple, it is a change in electrical resistance, which is inferred to involve a change in "chemical equilibrium," which is again inferred to be a change in molecular condition.

I can easily understand Mr. Argall's frank admission that his citations "do not support a crystallization theory for iron"; but I will leave others to decide whether they prove "that the molecular structure of iron can change and does change under different physical conditions and at atmospheric temperatures." With regard to Mr. Argall's question, "What is electrolysis but the direction, by means of an electric current, of the movement of molecules in electrolyte to form new bodies?" I beg to say that I do not pretend to know exactly what electrolysis is, but I strongly suspect that, whatever it is, it is not that. I cannot conceive, however, the remotest connection between this question and the one under discussion; and will, therefore, abstain from introducing a purely outside and wholly theoretical issue.

But a little investigation of Mr. Argall's theory itself may not be out of place. It is, if I comprehend it: (a) That the iron of new stamp-stems has a fibrous structure; (b) That this structure is changed during use, by the effect of repeated blows and vibrations, which cause the molecules previously arranged in fibers to separate and rearrange themselves in crystals; (c) That the result of this process is shown by the granular fracture when the stamp-stem breaks.

It seems to me that any stamp-stem thus fractured in service would break at the beginning, rather than the end, of such a process. The molecules cannot be expected to rearrange themselves without separating; and how they are to retain cohesion when they have once separated, so as to resist the breaking effect of shock until they have got comfortably crystallized, is not clear. The beginnings of separation are incipient fracture; and the experiments of Woehler and others, cited above, show that shocks producing such slight separation of particles may, by repetition, go on increasing the fracture thus begun, so that at last the piece breaks by the dissolution of its original, not of a secondary, structure. This conception involves no molecular theory whatever. It rests on the established fact that iron is made up of joined and cemented particles, which can be pulled apart; and that, when they are sufficiently pulled apart, the iron breaks. Such a conception explains all the phenomena thus far adduced, and it is scarcely necessary to set up an auxiliary and imaginary theory that the particles first separate, then reunite, and then break apart again, under strains which tended to fracture all the time.

The whole question of the fibrous structure of wrought iron and its supposed relation to strength has received much new light within recent years, especially in connection with the attempt at Avesta to produce fibrous soft steel in the Little-Bessemer process, by casting some slag with the steel. The peculiar lamination caused in puddled iron by the presence of intermingled cinder was thus reproduced in steel for the benefit of prejudiced consumers; but it was not shown that this structure gave increased strength. However, I will not now pursue that part of the subject.

[1] "Annales des Mines," vol. XIV., 1888, p. 6.

OCCIDENTE SUSPENSION BRIDGE OVER THE CAUCA RIVER, COLOMBIA, S. A.

We are indebted to Mr. Francisco Escobar, E. M., of Cleveland, Ohio, for the following brief description of this bridge, across the Cauca River, in Colombia, South America, from notes made on the ground. The bridge is being built by a company, in which the Antioquian government is chief stockholder. Antioquia is one of the states of Colombia. The bridge is chiefly remarkable for its flatness of arc, length of span and extremely small load capacity, having a clear span of 940 ft., with a center deflection of only 30 ft.

The bridge consists of four 4-in. cables, two on each side, built up of parallel wires (about No. 10 B. W. G.), whose tensile strength is 67.7 tons per sq. in. The wrapping will be No. 16 wire. The area of solid metal in each cable would be about 10.25 sq. ins., giving 41 sq. ins. for the four cables; a total tensile strength of 2,776 tons, with 57 tons as the weight of the cables. The working strength, with a safety factor of 3, would be 925⅓ tons, and the suspended weight to produce this stress on the cables, with the given deflection of 1-31, would be nearly 231 tons. Assuming the weight of timber required as equal to 112 tons, which is very small; and that of the suspenders at 3 tons, the total weight of the structure would be 172 tons. This subtracted from 231 tons leaves 59 tons for the maximum extraneous load to be allowed on the bridge. Mr. Escobar makes no mention of any stiffening truss, nor of any horizontal cables for taking up wind strain. According to the arrangement of the towers, the roadway was originally intended to be 26 ft. wide, but Mr. Escobar was told that this was to be considerably reduced. Assuming the width at 12 ft., the permissible live load will be only 10 lbs. per sq. ft.

It must, however, be remembered that the traffic is very light, for the present at least, being mainly pedestrians and mules; and it is to be hoped, says Mr. Escobar, that the curious crowd will not be allowed to fill the bridge, either on the day of its opening or at any other time.

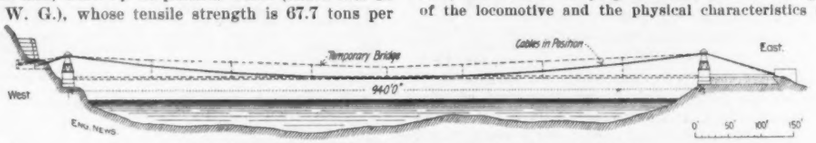
The towers are founded on solid rock and are built of brickwork to a height of 12 ft. above the roadway, and then crowned with an octagonal wooden framework. The brickwork is 17 × 16 ft. outside, with chamber inside 12 ft. square, thus making the walls about 2 ft. thick. The timber tower is built of 6 × 6 in. sticks of "comino," a very strong and durable native wood. The height up to the saddle is about 22 ft. and the saddle itself is made of cast iron, cast in sections, and will rest upon 12 3-in. rollers.

The west side anchorage is encased in the native rock; it is built of brick and encloses 84 U-shaped hooks, each 20 ft. long, 4 ins. between the sides of the U and made of 1-in. round wrought iron. These hooks are secured at the back by suitable washers and the strands of the cable will be secured to the hooks. A retaining wall resting upon the top of the west anchorage adds to its stability against sliding.

The eastern anchorage is of the common type and needs no especial description. The shoes are made of cast iron, yoke-shaped, 7 ins. thick at the middle and for a length of 22½ ins.; they then taper on each side. These shoes are pierced with six 1½ in. holes and four 1-in. holes, through which will pass the wire strands of the cables.

The suspenders will be 1-in. round iron; the shortest seen by the writer in the shop was 12 ins. long and the longest 35 ft. Their location was uncertain, but certain indications pointed to a spacing of 20 ft. apart. On this assumption, and taking the middle one at 12 ins., the longest suspender would be 32.75 ft.

Mr. Escobar explains that the absence of the engineer of the bridge prevented him from seeing any of the drawings or obtaining any data, except such as he could gather on the ground. He was directed by the Antioquian government to report upon the advisability of finishing the bridge. He reported the bridge "as the weakest, but most rigid of its kind," and "as a daring piece of engineering and a courageous departure from established principles and practice." He leaves the readers of Engineering News to draw their own conclusions.



A LONG SUSPENSION BRIDGE IN SOUTH AMERICA.

HOW CAN PRESENT METHODS OF RATING TRAIN LOADS BE IMPROVED.*

By W. W. Wheatley, Car Accountant, West Shore R. R.

If you ask the different officials of a railway what constitutes a load for a locomotive, they will, with few exceptions, tell you a certain number of loaded cars, the number varying with the size and weight of the locomotive and the physical characteristics of the road. They will also tell you that the number of loaded cars which an engine should haul is determined in a general way by the officials of the transportation and motive power departments, but that almost unlimited discretion is vested in train despatchers and yardmasters to change the rating in accordance with varying conditions of track and weather.

A train load, as it is now understood, is so many loaded cars, whether those cars contain one ton or thirty tons of freight per car. It is, therefore, evident that great inequality must necessarily exist in the weight of different trains on the same road, on the same day and under precisely similar conditions of track and weather. In comparing the performance of two or more locomotives of equal size and weight over a certain piece of road, it is of paramount importance to know the weight of the trains drawn by them. The fact that each one was given 40 loaded cars, of which the total tare weight was 480 tons, will not explain why one locomotive was able to cover the division in less time and with a smaller expense for fuel and supplies than the others. The tonnage of freight in the cars is of quite as much importance as the weight of the cars themselves, and when the balance is struck between earnings and expenses it is of vastly more importance. If one locomotive carries 1,000 tons of freight in its 40 cars and the others not more than 300 to 500 tons, the conditions are entirely different, and the comparative record of performance will probably show it. If it were desired to make an accurate test of locomotive efficiency, it would be necessary to make the trains of nearly equal weight. If the cars selected for one train contained an average of 50,000 lbs., or 25 tons per car, and the cars selected for another train contained an average of 20,000 lbs., or 10 tons per car, it would be necessary to give the latter train more cars to equalize the weight.

The present method of rating train loads upon the basis of a certain number of loaded cars was established, no doubt, upon the presumption (which is not borne out by experience) that freight cars would

*A paper read Sept. 20 before the New York R. R. Club.

nearly always be loaded to almost the limit of their capacity. I am led to believe from my own experience, and from certain figures which I have obtained from the Interstate Commerce Commission and other sources, that the average tonnage per loaded car, upon a majority of the railroads of this country, is not above one-third of the maximum car capacity. The reason it is not higher is because the loading of cars is not subject to the critical supervision which is exercised in other details of the transportation service.

At the recent annual convention of the Car Accountants' Association, the representative of the Grand Trunk road, speaking upon the subject of the light and unremunerative loading of freight cars, said:

So far as my information extends, no systematic supervision over the loading has been attempted; and consequently this very important economic question is largely left in the hands of agents and freight porters, whose only aim is to get the freight out of their sheds, and who naturally take very little thought or responsibility as to the cost of its carriage. They, therefore, load 20 or 30 tons, or 20 or 30 pounds, into a car, with equal assurance and without any apprehension of either praise or blame.

A very bad case cited by the Grand Trunk representative was one which, I believe, has had its counterpart more than once on other roads. It was a car belonging to a New England road which came to the Grand Trunk under bonded seals and locks, and upon through billing to a point in Illinois, and which contained the precious cargo of only one tub of butter, under 50 lbs. in weight, on which the Grand Trunk's proportion of earnings for 500 miles was 21 cts., while the payment of car mileage for the use by the Grand Trunk of the New England road's car was $3.75. Of course this was an exceptional case, but it illustrates in a striking way the general apathy which has prevailed among railroad employees and officials upon this very important question.

To obviate the reckless light loading of cars, the Grand Trunk people, we are told, established transshipping staffs, "the result in one day being the doubling up of the contents of 64 cars into 14. In one month, at a single junction point, the loads of 1,151 cars from one connection point were put into 473; a saving of haulage and mileage of 678 cars for a distance of 500 miles." On these 678 cars the payment for car mileage alone would have been over $2,000. I do not know how many cars make a train on the Grand Trunk road, but it is fair to assume that these 678 cars, if made up into trains and sent forward, would have made 18 or 20 so-called full trains under the present erroneous system of rating train loads. It is almost incredible that similar, but perhaps slightly less aggravated conditions have been permitted to exist, as, I believe, is the case upon many of the railroads of this country without exciting comment; yet, whenever facts have been furnished, they have shown that the total average tonnage per car is not above 10 tons, or one-third of the maximum car capacity.

On a railroad with which I am familiar they have recently been giving some attention to the light loading of cars, and to the comparative weights of trains, east and westbound, with different classes of freight. The heavy flow of traffic is eastbound, and is of such a character that the average tonnage per car is high. About 40% of the westbound car movement is empty. When, in the course of their investigation, they came to an examination of the average tonnage of westbound loaded cars, the first thing that they discovered was that 52% of all the loaded cars received from their Eastern connections contained less than 5,000 lbs. per car, and the average revenue tonnage in all loaded cars coming from Eastern connections was only 11,700 lbs. Many of these light-loaded cars were foreign cars which they did not want, and upon which they were paying large sums for car mileage. In turn, they delivered them to their Western connections, and they presumably permitted them to go through to destination with the light loads, paying unnecessary car mileage and counting each car in the make up of trains as a fully loaded car.

In figuring the weight of westbound trains, it was found to be ridiculously small when compared with eastbound trains hauling an equal number of loaded cars. It was no unusual thing to find in one westbound train 10 to 15 cars designated in rating the train load as loaded cars, which altogether did not contain more than enough freight to make one good car load. This made it evident that westbound trains, made up of cars received from Eastern connections, the loading of which the road in question could not control, were being run with much less than the usual train load, although they were being given the number of cars at which the engines were rated. In one month, by a little transferring and bunching of freight at one junction point, they succeeded in reducing the percentage of cars containing less than 5,000 lbs. from 52% to 27%, and in largely increasing the number of loaded cars per train per mile run. This afforded a reduction not only of the number of cars handled with a given tonnage, but also a reduction of the number of trains run, and effected a very gratifying economy in car service and in train service.

It will be noticed that the figures thus far given refer exclusively to traffic westbound, which is in the contrary direction to the prevailing heavy traffic stream. It was not a difficult matter to determine the existing inequality of the weights of cars and trains carrying various kinds of freight in the direction of the greater volume of traffic. On nearly all the trunk line roads it is customary, for obvious reasons, to make up separate full trains of certain commodities when practicable; for instance, a full train of stock; a full train of dressed beef or provisions; a full train of grain, or a full train of coal. Quicker time being demanded on stock, dressed beef, provisions, and other perishable freight, it is usually customary to give trains carrying such commodities eight to ten cars less than trains carrying grain, coal and other heavy freight. This custom was probably established upon the presumption that cars loaded with certain classes of commodities would nearly always contain about the same average amount of tonnage as cars loaded with other commodities. From the following figures it will be seen that a train carrying 40 cars of perishable "rush" freight, such as cattle, dressed beef or provisions, actually weighs only about half as much as a train carrying 40 cars of grain or coal. Why, then, is it necessary to make a further discrimination of 8 or 10 cars in favor of the locomotive hauling the perishable freight? After weighing a large number of cars containing various kinds of freight, it was found that cars containing dressed beef or fresh meat average about 22,000 lbs. per car; cars containing provisions, cattle or mixed freight, about 25,000 lbs. per car; cars containing coal, about 44,000 lbs. per car; cars containing grain (except oats), about 48,000 lbs. per car.

When these average weights are compared with one another, and with the average tonnage of loaded cars containing mixed merchandise freight received by the road in question from Eastern connections en route westbound, which, as I have stated, was found to be only 11,700 lbs. per car, it is at once apparent to all thoughtful minds that the plan of rating train loads upon the basis of the number of car loads, without reference to the tonnage, when considered in its economic aspect, is the poorest plan that could have been selected. It makes it plain that freight trains are now being run upon nearly all railroads whose traffic is not largely coal and grain, with not more than half the amount of tonnage which the locomotives are capable of drawing. The remedy lies in the direction of giving more attention, first, to the loading of cars, and, second, to the loading of engines. Both cars and engines can be made to carry more complete loads.

To accomplish this most desirable object yardmasters, train despatchers and others concerned with the train movement must know how much weight each locomotive is capable of drawing, and when trains are being made up they must have some method of knowing that each locomotive is loaded approximately to its capacity. It would not be a difficult matter to have agents show upon each running slip for a loaded car, and upon the cards on each side of a loaded car, the number of pounds of freight it contains. This would enable yardmen and train despatchers to check each locomotive with so many pounds or tons of freight, making due allowance for the tare weight of the cars. Conductors' reports to the car record office might show opposite each loaded car the amount of tonnage it contained. This would enable the car accountants to make reports daily, weekly or monthly of the tonnage per train or per locomotive. If a locomotive drawing 500 tons is stalled on a grade, while another locomotive of the same class drawing 1,000 tons passed over all right, the Superintendent and Master Mechanic would be likely to make an investigation, whereas, under the present system of blindfold engine rating, they would conclude that the first train had the heavy load, while the second one had the light load.

In the concrete, the question to which I invite your attention is the problem, from an operating standpoint, of making your locomotives and cars carry more complete loads. The economical effect of making five cars carry in a given time the tonnage now carried by ten, and of making five locomotives and train crews do the work in a given time now being done by ten, is too apparent to require argument. The net earnings depend as much upon the outgo as the income. It is believed that we have now arrived at a point in railway history where (if the income cannot be increased) the outgo must be diminished. Our subject this evening has to do entirely with diminishing the outgo; or, to be more explicit, with diminishing the expense of operation. The largest single item of operating expenses is the cost of conducting transportation, which includes all of the expenses chargeable to car service and train service. The efficient and economical handling of the car and train service is, therefore, in a large degree the basis of the successful financial operation of railways. Of two railroads, that one will obtain the best financial results and will ultimately outstrip its rival, that is able to haul the larger number of fully loaded cars and gain the greater amount of revenue tonnage per engine per mile run.

Discussion.

Mr. A. E. Mitchell (N. Y., L. E. & W.) said that co-operation between the motive power and transportation departments would certainly produce better results than are now obtained. Since the dull times, the Erie has increased the number of cars per train with excellent results. On coal and grain trains three or four more cars per train are hauled with little increase in fuel consumption. He believed that eventually train loads would have to be measured by the actual weight hauled.

Mr. Wattson (West Shore) said that a common difficulty is that trains are overloaded as well as underloaded. Trains which are to make quick time are supposed to be given lighter loads, but as a matter of fact, they may happen to get heavily loaded cars and are then unable to make the time required.

Mr. Donnelly (Lehigh Valley) said that the carload was a greatly variable unit. Under the present system we have, besides the variation in loads, the changes of weather, and even the quality of oil used in the journal boxes may make a difference. A short time ago he found that the engines on the Lehigh Valley were sticking with trains with which they formerly had made good time. On some of the lighter grades where the train used to drift along as fast as it should go by gravity, it was necessary to use steam to pull the train. Just what the trouble was could not be ascertained and it was finally necessary to cut down the number of carloads per train about 10%, right in midsummer. Now, however, the trains are hauling more easily. A great many cars have been standing a long time out of service, but now the demnad for them is more active. He had found that after a car had been standing out of service it would run harder for some time than a car in steady use.

Mr. West (N. Y., O. & W.) said that he recently received a detention slip report where the engineer said, "I stalled at one point on the road with 160 lbs. of steam." It appears that the trouble was that the cars were loaded with sugar. A general smile went around as it was remarked that that was not the first thing which had been stalled by sugar this summer.

Mr. Gowart (Penn.) related a case of an engine whose rating is 32 loaded cars being stalled with 18 60,000-lb. coal cars. The transportation department makes no difference in making up trains between cars of five-tons load and those of 30-tons.

Mr. Wattson said that on lines where the traffic is largely in one direction, if engines were properly rated they would haul longer trains going in the direction of light traffic and the locomotives not needed would run back light, by which they would get back, ready to haul another train in the direction of heavy traffic in much less time.

The discussion here turned on the matter of handling very long trains. Mr. Forney said the late Howard Fry hauled a train of 100 cars on the Northern Central R. R. as an experiment; there was a saving in wages of trainmen, etc., but it was difficult to handle a train of such a length and signal from the caboose to the locomotive. Mr. Bradley said that 75 cars of grain were once hauled over the whole length of the West Shore R. R. in one train, but with the difficulty above stated. Mr. Mendenhall said that trains of 100 coal cars are hauled daily on one part of the Pennsylvania R. R. They are eight-wheel cars and will average 30 ft. in length and they are hauled by one locomotive. Mr. Donnelly said that 100 eight-wheel cars had been run, in one train, over the Lehigh Valley, and there was no trouble in doing it if sufficient time was available, but such trains cannot get on and off a siding without much delay. There was no difficulty so far as the strength of the locomotive or the cars was concerned. On a road with nothing but ordinary freight trains and no fast freights, which are really more troublesome than passenger trains, there is no difficulty in handling such long trains. President Blackall asked if it could be done with cars equipped with the M. C. B. couplers. Mr. Donnelly replied that it could, much better than if the train were equipped with the old drawbars. The only difficulty now is that all cars have not the M. C. B. couplers, and in going down grades a train will sometimes break in two or three pieces. The couplers do not often break by pulling out but by bumping together. When the M. C. B. coupler is on all the cars there will be no trouble. Mr. Mendenhall said that the breaking in two of trains depended altogether on the profile of the line. In passing through dips and sags, a very long train is pretty sure to be broken. The piece of road where the Pennsylvania handles such long trains is along the Susquehanna River from Columbia to

Harrisburg, which is practically level, and it is the only point where such long trains are handled on that road. There are no break-in twos, but it is a double-track road and no passenger trains run on the freight track, so no backing-up with these trains is necessary.

THE MYRTLE AVE. IMPROVEMENT ON THE BROOKLYN ELEVATED RAILROAD.*

By O. F. Nichols, Chief Engineer.

While heavy grades are objectionable on elevated as well as surface railways, the use of double stations, as distinguished from island or intertrack stations, increases operating expenses more rapidly than heavy grades. Double stations are frequently convenient, sometimes necessary, always expensive. Could the Manhattan Railway Company do without them, it would pay nearly 1% larger dividend on its stock.

The present paper describes a single attempt to improve grade and stations on the Brooklyn Elevated R. R., the difficulties met and the methods of overcoming them, and the ensuing profit. The grade on the surface of Myrtle Ave. reached 4% for some distance east of Raymond St., and necessitated a heavy grade if the tracks of the Hudson Ave. and Myrtle Ave. lines were to meet at a common low elevation. Nearly all the stations on this line were island stations. The Grand Ave. station was one of the exceptions, and formed a transfer for passengers between the Myrtle and Lexington Ave. lines by means of overhead footbridges. To change the next two adjacent stations to island stations would introduce large economy. The Washington Ave. station was built after the road was completed, and was placed on a grade of 1.4% and permanently fixed in position by agreement. Engines frequently stall in starting heavy trains on this grade. The long stretch (1,700 ft.) of 2.06% grade between Navy St. and Carlton Ave. caused many accidents to engines, and more trouble than any other equivalent length of road.

A proposition was made in 1889 to change the two stations and the steep grade, but it was deemed impracticable, on many accounts, and it was abandoned until 1893. It was then proposed to run five-car trains over Myrtle Ave., and to make it easier to do this, it was decided to cut the heavy grade in two, lengthways, and to lengthen the upper part of it. Studies were made for changing the grade below Carlton Ave. and above Washington Ave., also for changing the two stations to island stations. The financial depression of last year and the use of electric cars on the street beneath caused the work to be completed only as far as the ironwork for the new station, leaving the balance to be finished at a later day. The preliminary estimate of cost was $40,000.

The lowering of the grades between bents 68 and 92 was regarded as the most serious portion of the work, since it must be done without interference with travel and with entire safety to the public. Plans and estimates were asked for, but nothing more satisfactory was received than those already prepared, and no contractor would take the work except on a percentage of its cost. It was, therefore, decided to do it by day labor. The earlier plans proposed cutting a section out of each column a little above its base, and splicing the two parts together with plates riveted on the sides. This avoided the awkward cutting of about 20 columns on which the "drop-end" girders extended down the side of the column about 2 ft., and also retaining the rigid connection between columns and girders, which it seemed wise to maintain as a safeguard against any tendency to overturn. The months of May and June were most available in which to do the work, as the travel is then lighter. It was important to finish it, also, before August, when the wires of the surface electric roads were to be attached to this structure.

An effort was made and much time lost in an attempt to cut the columns by means of a cold saw. An apparatus was finally made which could be worked either by electric power or by hand. This, it was estimated, would cut a column in less than half an hour. The machine weighed 600 lbs. and cost $500. An actual test showed that all the channels could be cut by hand for about the price of the saw, and machine cutting was finally abandoned. The first plan was to cut the columns near the base, but the difficulties were much increased by an attempt to handle a heavy machine at a distance above the ground. The plan of cutting at the top of the column was developed on account of the greater difficulty in splicing at the bottom, and, also, that the roadway below must be kept clear for the passage of vehicles, the trouble being increased by the relaying of the surface railway tracks and the repaving of the streets, which were progressing about the same time as the work on the structure.

The columns were firmly fixed in cast iron bases about 3 ft. square and bolted to brick masonry piers, and it was finally decided to take advantage of the columns to steady the lowering apparatus, and to cut the columns at the top. Two vertical sticks of southern pine timber were suspended from each end of the transverse girders by built tee irons bolted to the sticks and to the girders, to aid in preventing tilting. Two channel irons, held together by four bolts, formed clamps placed at top and bottom of the columns to steady the timber; the middle bolts served as separators, and the end bolts as guides.

Two 60-ton hydraulic jacks were used, one under each of the two smaller sticks at the ends of the girder. The larger timbers were left 12 ins. short of reaching the main blocking; the space was filled by carefully dressed blocks, 4 ins. thick, 14 ins. wide and 3 ft. long, each bolted through edgeways, to prevent splitting. The brackets between the columns and girders were cut out, the blocking carefully placed, and lock wedges driven, to give a firm support. The side plates and angles forming the caps of the columns were removed and placed in the new position for the caps. The horizontal seat plates were cut out to fit the back channel, which was left intact, and the edges of the vertical angles so cut as to make sure of their entering the channel freely. When all was ready, the side channel of the column was cut off by two men, one man holding the tool, while it was struck with a heavy hammer by another. The channel would be frequently cut by two men in two hours. The men worked on a platform formed of loose planks, enclosing the columns and suspended by ropes. When the new column cap was completed, blocks 6 × 6 × 8 ins. were piled on it in pairs and wedged under the end of the girder, to give additional support. The cutting of the columns at the summit amounted to 5 ft. 7¼ ins., and after three bents had been cut, the girders were at once lowered 4 ins. The cutting was extended until the girders at the summit could be lowered 12 ins. All the cutting was then completed, and the general lowering began, commencing at the easterly or upper end, so as to produce grades of not more than 0.6%. The lowering was done by two gangs of six men each, one on each side of the street at each of the columns, two handling the jack, two the blocking, and two adjusting the clamps. The jacks had 12 ins. lift, with let-off cocks, by which the lowering could be checked at any point.

In lowering, the jacks were first set up so as to relieve the pressure from the 4-in. block, one block was then backed out, and one 3 ins. thick inserted, this in turn backed out, and one 2 ins. thick inserted, then one of 1 in., so that in case of accident there could never be a drop of more than 1 in. After 12 ins. had been lowered, the girders were blocked directly on the iron columns, so that the jacks could be slacked and the timber sawed off 16 ins., then another lowering of 4 ins. brought the blocking to the standard of 12 ins. When a 4-in. drop was carried over the line, generally one girder at each end would reach its final bearing. Such a drop was carried over the line in 3½ hours.

No lowering was actually done under a moving train, although this was not a necessity. All trains were run over the entire work at reduced speed. The lowering generally took place between 10 a. m. and 5 p. m. when the travel was lightest—the intervals between trains being about 1½ minutes. The shortening of the track due to the lowering was about ¾ in. There was no shearing of bolts, and the shortening seemed to distribute itself uniformly, and to be taken up by the slotted holes at one end of each span. A length of 2 ins. was cut out of the rails, as they were previously quite tight on the grade. The entire force employed consisted of 30 men, 2 carpenters, 6 drillers, 8 riveters, 14 trackmen, helpers, etc.

The transverse girders at Vanderbilt Ave. are strong enough to carry the island station; it was, however, necessary to reinforce the corresponding girders at Washington Ave. and Cumberland St. This was effected by placing subgirders under the old ones, the adjacent flanges being riveted together. The track girders had to be removed and replaced with new ones. This was done a span at a time, and the floor systems of the new spans were placed between midnight and 5 a. m., when trains were run at intervals of 15 minutes in either direction.

The old track system having been removed, with the lateral bracing and fastenings of the track girders, they were lowered to the street by gin poles, operated by hand winches, the heaviest weighing 14,000 lbs. When these were out of the way, the floor beams and stringers of the through span were lowered into position by hand falls from a small A frame resting on the girders. When these were secured, the new ties and rails were laid in place and connected up. This work of changing the entire track system and supports on 60-ft. spans in from six to seven hours was probably the most trying and expeditious of all the work done on the improvement, as only 8 or 10 men could be used to advantage.

There were 18 other girders for new platforms placed in position, as the old ones were too light for the work. They were handled with great ease by the use of a boom derrick, working from the center over the side of a flat car. All heavy material was delivered by lighters at the dock, about one mile distant. The old material had to be handled and carted away at night, and the expense was heavy.

The station buildings were removed by raising them from the floors and sliding them over on rail skids to a heavy flat car, and moved by a locomotive to their new position. They were then slid over into place and dropped down on the new floors previously prepared. The weight of each was about 15 tons. Light needle beams formed the frame on which the buildings rested while moving, and the sliding was done with 10-ton hydraulic jacks. The car passed easily around the curve and no trouble was anticipated at any other point. No station was closed to business, except from midnight until six in the morning of the two nights when the buildings were moved. About $3,000 was saved by using the old buildings instead of building new ones. The total cost of the improvement was $39,534.32. This makes no allowance for tools and materials left over, which were available for other work.

The direct saving by the use of the two island stations is estimated at $2,920 per annum, while the annual interest at 5% on the cost is $2,006. There is a saving also due to the economy in the operation of the trains, due to the lowering of the grade. They were formerly raised 14.4 ft. in 800 ft., and they are now raised the same height in 1,300 ft., in the first case 0.58 minute being the time occupied by the trains in passing, and in the last case 0.84 minute. Nearly 400 trains are raised through this height each day, and the estimated saving in horse-power per annum by lengthening the time is 4,500,000, or a total saving from this item of $1,125 per annum. These estimates would show that the change would have been a profitable one had it cost 3⅛ times as much.

* Abstract of a paper read before the American Society of Civil Engineers, Oct. 3.

PERFORMANCE OF COMPOUND LOCOMOTIVES ON THE W. N. Y. & P. R. R.

The best test of the comparative efficiency and economy of different locomotives is that obtained from regular running of the engines in similar service for a sufficient length of time to give a fair average result. The Western New York & Pennsylvania R. R. has a Baldwin four-cylinder compound engine which has been in service for three years, and Mr. R. Bell, General Superintendent, states that it is giving good satisfaction and showing about 15% economy in fuel over simple engines of the same class. We are indebted to Mr. Bell for performance sheets of engines Nos. 171 and 175 (which are identical, except that the former is a simple and the latter a compound engine) from June 1, 1892, to May 31, 1893, and from June 1, 1893, to May 31, 1894, the totals of which are given in the following table. The engines are of the same class and same build in every respect, except for the compounding, and they run opposite one another on the same trains:

	No. 175. — Compound. —		No. 171. — Simple. —	
	1892-93.	1893-94.	1892-93.	1893-94.
Mileage	32,697	30,210	40,302	28,629
Cost of repairs	$1,462.73	$1,045.96	$667.62	$1,358.86
Fuel, cords of wood	5.75	9.25	9.00	11.25
" tons of coal.	1,542.8	1,484.4	2,263.8	1,540.4
" total cost	$1,830.07	$1,864.25	$2,696.12	$2,028.44
Stores:				
Qts. headlight oil	482	446	551	457
" lubricat'g oil	693	733	898	607
" valve oil	513	502	433	308
Pounds of waste.	408	344	439	315
Total cost	$137.41	$131.68	$140.73	$106.88
Wages, enginemen, firemen, wipers.	$2,070.03	$1,848.29	$2,738.95	$1,878.49
Total expenses of engines	$5,500.84	$4,890.18	$6,243.42	$5,372.67
Miles run:				
Per ton of coal.	21.1	20.4	18.0	18.0
" qt. engine oil	47.2	41.2	44.9	47.1
" qt. valve oil	63.7	60.2	93.0	93.0
Cost pr mile, rep'rs	$448	$346	$166	$475
" " " fuel.	559	617	669	708
" " " stores	42	43	35	37
Cost per mile run for enginemen, firemen, wipers.	633	612	679	656
Total cost, mile run	16.82	16.18	15.47	18.76

Both are consolidation freight engines, built by the Baldwin Locomotive Works. The compound engine has cylinders 13 × 26 and 21 × 26 ins., weighs 129,600 lbs., with 116,550 lbs. on the driving wheels, and carries 175 lbs. steam pressure. The simple engine has cylinders 19 × 26 ins., weighs 126,870 lbs., with 110,650 lbs. on the driving wheels, and carries 160 lbs. steam pressure. Both engines have driving wheels 4 ft. 2¼ ins. in diameter, a rigid wheel-base of 14 ft. and total wheel-base of 21 ft. 9 ins. The heating surface is 1,879 sq. ft. and grate area 29 sq. ft. Bituminous coal is the fuel used.

CONTINUOUS AND INTERMITTENT SAND FILTRATION OF WATER.*

By George W. Fuller.**

Bacteriology teaches us that water may be sterilized in three ways: By means of chemicals, heat and filtration. While chemicals have been of much aid in surgery, by bringing about antisepsis and asepsis, it is very improbable that people would allow their drinking water to be drugged with chemicals, even with the view to removing dangerous bacteria. Indeed, such a method might prove very dangerous in many cases. Heat is a much safer means of sterilization, and its application in the household has doubtless done much good. But on the ground of practicability and economy, as well as of reliability, in the light of our present knowledge, each of these methods of sterilization for the removal of disease-producing germs from water supplies drops into relative insignificance when compared with filtration.

At the annual meeting of this association at Chicago last year I had the honor of presenting to you some of the results of the investigation upon water purification made by the State Board of Health of Massachusetts. It was then shown that all disease-producing bacteria in the Merrimac River at Lawrence may be removed by slow intermittent filtration through fine sand and loam. But this is not all that the filter accomplished in the removal of bacteria. Out of 102 analyses, 58 indicated that the filtered water was absolutely sterile. Furthermore, the few bacteria which were found in the effluent from time to time belonged to the most hardy species of water bacteria, many of which existed in the form of spores and which, let it be understood, are not killed by the ordinary application of heat or of chemicals.

Spring water obtained from favorable sources has repeatedly been found to be absolutely sterile. This is the result of natural filtration. This is nature's method of purifying water, and the efficiency of natural filtration may be attributed to the retention of the bacteria within the filter under an unfavorable environment. The natural consequence of these unfavorable conditions is the survival of the fittest bacteria. Now the evidence at hand shows that the disease-producing bacteria are among the first to succumb, because farthest removed from their natural habitat. The non-pathogenic bacteria eventually perish, also, but, unlike the case with the dangerous species, this does not happen until they have established a home and breeding place within the filter. Under the most favorable conditions, filtration may be conducted so that no bacteria pass through with the filtered water. This can only be done under circumstances where the discharge from the filter is sufficiently removed, by time and distance, from the main seat of bacterial activity.

We know that there are a score or more of germs which may produce specific diseases in mankind. There are many more species which are of the utmost benefit to the human race. They accomplish their work by decomposing and nitrifying processes, and convert objectionable organic matter and disease germs to harmless mineral matter. The benefit to mankind of the saprophytic bacteria cannot be overestimated. In this connection it is instructive to quote the conclusion from Pasteur's admirable investigations:

> Whenever and wherever there is decomposition of organic matter, whether it be the case of an herb or an oak, of a worm or a whale, the work is exclusively done by infinitely small organisms. They are the important, almost the only agents of universal hygiene; they clear away more quickly than the dogs of Constantinople or the wild beasts of the desert the remains of all that has had life; they protect the living from the dead; they do more—if there are still living beings, if, since the hundreds of centuries the world has been inhabited, life continues, it is to them we owe it.

In no place in nature are the opportunities for this bacterial activity more favorable than in filters. We find that the purification of water, with the removal of disease-producing germs by filtration, is nature's method. We may go a step farther and state that in the purification of water that method is safest which follows most closely nature's method, and which is least dependent on human agencies.

Nature's method of filtration means the intermittent application of water to sand or soil in rates equal to the rainfall. The economic adoption of sand filtration, particularly as it has been practiced successfully for many decades in Europe, differs from nature's method, strictly speaking, in that the rate of filtration is much higher and the surface of the sand or soil is covered with water for long periods of time. The essential, underlying principles, however, are the same, because the results are produced by bacterial activity which permanently exists in all filtering materials.

While the removal of pathogenic bacteria by chemicals, including coagulants, and by heat, will forever be directly dependent on human attention and judgment, I venture to predict that the day will come when the knowledge of filtration among sanitary scientists will be such that filters may be constructed and operated by which water, free from objectionable bacteria, will be supplied to hundreds of thousands of citizens and require the attention of a mere handful of men.

Even under these circumstances the opportunity for exercising personal attention and judgment can be reduced to very narrow limits. In order to obtain this desirable end it is necessary to study thoroughly the laws of filtration from engineering, bacteriological, chemical and hygienic points of view.

For the past seven years the State Board of Health of Massachusetts has been studying the laws of filtration at the Lawrence Experiment Station. In a certain sense, the Lawrence work may be regarded as investigations upon nature's ways of working, with a view to their more economical and advantageous application to the problems in actual practice. The results of these investigations have been published from time to time in the annual reports of the board. It is fitting on this occasion that I review some of the more important points upon the filtration of water in the annual report of the board for the year 1893, which is just issuing from the press.

In the operation of a filter, one of the important points is the rate at which water passes through the filtering material. As a result of European experience, the conventional limit has been set at from 2,000,000 to 3,000,000 gallons per acre daily. Recent results obtained at Lawrence show that the Merrimac River water may be filtered through proper materials at rates of 4,000,000, 6,000,000 and even 8,000,000 gallons per acre daily, with practically no diminution in the bacterial efficiency. Farther investigations are necessary to show whether filters may work at this rate for an indefinite time without a period of absolute rest. The maximum rate of filtration allowable depends upon the quality of the water and the quality and quantity of the sand. The advantage of higher rates of filtration with undiminished hygienic efficiency is apparent, because it means reduced size and cost of the filtering plant.

It is well worth noting that in the operation of water filters a greater hygienic efficiency is obtained from uniform than from fluctuating rates of filtration. The disadvantage of fluctuating rates has been demonstrated in the case of some of the older water filters in Europe. From the Lawrence work it appears that with filtering materials of increasing degrees of coarseness and with higher rates of filtration, the advantage of uniform rates becomes more marked.

Concerning the depth of material, it has been found that, while very satisfactory results may be obtained under favorable conditions, from filters 1 to 2 ft. deep, the deeper 5-ft. filters are safer.

The investigations indicate that, within the limits in sizes of sand grains which would be usually employed in filtration, the finer sands are ordinarily slightly more efficient in removing bacteria than the coarser ones.

It has been stated that an objection to sand filtration of water is that the hygienic efficiency is materially reduced during the period which immediately follows the scraping of the surface to relieve clogging. In the light of recent Lawrence results, this period of somewhat diminished efficiency appears to be largely due to mechanical disturbance of the main body of the filtering material during the process of refilling the filter with water after draining and scraping it. The effect of this mechanical disturbance, caused largely by escaping air, is to create places of lessened resistance to the passage of water through the filter, thereby allowing the water to pass through certain limited areas of the material at very high rates and under abnormal condition of filtration.

It has been found that there are reliable and practicable means of overcoming this difficulty; one method, for instance, is by slowly filling the filter from below after draining.

In regard to the application of water to filters, there are two methods: First, the continuous method by which the filters are continuously operated with the surface of the sand constantly covered with water; and second, the intermittent method by which, from time to time, the water is shut off from the surface for a certain period and the water allowed to drain out of the sand, the pores of which fill with air. The advantage of intermittency is that it provides, within the filtering material, an additional amount of oxygen, with which the bacteria may perform their functions.

So far as the experimental filtration of the Merrimac River water at Lawrence is concerned, there is no marked difference in the average results which may be obtained by the two methods of application of water. The reason of this is that a practically sufficient quantity of free oxygen is held in the water as it flows onto the filters. In 1890 it was shown that a small amount of oxygen (1 to 3%) in the air of a sewage filter was effective, provided that the air was changed so often that some oxygen was always present at every point. That continuous filters at Lawrence are supplied, under ordinary circumstances, with sufficient oxygen is shown by the fact that it has never been found absent in the effluents as they flow from the filters through trapped outlets. This is confirmed by the results of long series of analyses of the effluents from both continuous and intermittent filters. Moreover, the analyses of the filtering materials themselves showed that the sand from intermittent filters contained substantially the same amount of organic matter as that from corresponding continuous filters.

To make clearer the interpretation of the investigations upon this point, let me state that the free dissolved oxygen in a water depends chiefly upon temperature and pressure. As there is practically no increased pressure upon water as it flows on to filters, the amount of free oxygen held in the water varies with the temperature, and, generally speaking, cannot exceed the point of saturation for the given temperature, even after aeration. The maximum quantity of free oxygen held in water varies from 1.47 parts at 32° F. to 0.81 part at 80° F., expressed by weight in parts per 100,000. Now it will be seen that the quantity of free oxygen, which is absolutely essential to chemical and bacterial purification of water by sand filtration, cannot exceed a fixed quantity in different waters under parallel conditions of pressure and temperature; while the amount of organic matter in waters under the same conditions may increase within wide limits. The quantity of free oxygen within the filter, which will suffice for the complete purification of the water, must be in proportions corresponding to the organic matter. For this reason it is clear that spring waters and other waters which contain relatively small proportions of organic matter can be filtered by the ordinary continuous method with complete success, while the filtration by this method of sewage, which contains a comparatively large quantity of organic matter, is an absolute failure. Intermediate between the two, in point of organic matter, a line must be drawn, below which either the continuous or the intermittent method of application of water to filters is allowable, but above which the intermittent method can alone be used with safety. Not only the quantity but also the quality of the organic matter must be taken into consideration, for it is well known that animal matter is more easily decomposed and mineralized than organic matter of vegetable origin.

With regard to the experience at Lawrence, it may be stated that during midsummer, the period of greatest bacterial activity within the filters, and also the time when the amount of free oxygen in the Merrimac River is least, intermittent filters give somewhat better results. On the other hand, during midwinter, when the Merrimac River is saturated with oxygen, the advantage appears to lie somewhat in favor of the continuous filters, because they are more protected from the effect of freezing weather.

In order to obtain the required amount of free oxygen, it is necessary in the case of some waters, and absolutely essential in the case of sewage, to charge the pores of the filter with oxygen from time to time, because the quantity which can be applied in the water is limited by the point of saturation. Therefore, the arbitrary adoption of the continuous or intermittent method of application in the filtration of a certain water is not advisable; it becomes a matter of adjustment of the necessary quantity of free oxygen within the filter to the amount and quality of the organic matter in the water under consideration.

We have now considered the way in which sand filtration does its work, and referred to some of the controlling factors in its operation. Let us next turn to the hygienic results obtained by filtration and to their interpretations.

At the Lawrence Experiment Station, during the year 1893, there were made more than 12,000 bacteriological analyses in repeatedly testing the efficiency of 20 individual filters of different construction and operation. The average results of these analyses indicated that 98.54% of the number of bacteria in the Merrimac River water were removed by filtration. This average includes all normal results, many of which were obtained from filters and under conditions which would not be recommended for adoption in practice. Under reasonably favorable conditions, the removal was from 99 to 99.5% of the number in the applied water. Of the average percentage (1.46) of the bacteria which remained in the filtered water, in actual numbers 140 as compared with 9,100 in the river water, a majority appear to belong to the most hardy forms of water bacteria. Furthermore, it has been learned that from 15 to 25% of these bacteria are present in the form of spores, which, as has been stated above, are not killed by the ordinary application of heat and of chemicals.

In studying the hygienic efficiency, we are not dependent alone on the results from these water species of bacteria. Billions of typhoid fever germs, B. coli communis and B. prodigiosus, a species which is similar in its mode of life in Merrimac River water to B. typhi abdominalis, have been cultivated and applied to the filters. When these germs were put on to the filters, in numbers corresponding to the water bacteria, under high rates of filtration, they passed through the filter into the effluent in very limited numbers. They

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* Abstract of a paper read at the Montreal meeting of the American Public Health Association, Sept. 25, 1894.

** Biologist in Charge of the Lawrence Experiment Station, State Board of Health of Massachusetts.

were present in the filtered water, however, in relatively much smaller numbers than the common water bacteria. Under parallel conditions the ratio of B. prodigiosus to common water bacteria in the effluents appears to range between 1 to 10 and 1 to 5. The average number of these germs, applied in pure culture to the filters, was 6,000 per cu. cm., of which 99.81% were removed by the filters.

The reason why such large numbers of these specific bacteria were applied to the filters was to test the efficiency of filtration under different conditions, and to obtain numbers sufficiently great to show clearly the laws of filtration. It will be admitted by every one that the tests upon the efficiency of the filters in removing these bacteria were far more severe than would ever occur in practice. Looking at the experiments more carefully, it is seen that these germs were applied to the filters for weeks, in numbers equal to those of the ordinary bacteria in the Merrimac River at Lawrence. At times, in fact, the numbers were a hundred-fold greater. In order to appreciate more fully these experimental conditions, let me state that in order to obtain, in actual practice, corresponding numbers of typhoid fever germs, it would be necessary to add to the drainage area of the Merrimac River, above Lawrence, a population sick with typhoid fever and equal in number to the present inhabitants. This statement assumes, of course, that there would be conditions corresponding to the present ones with regard to sedimentation, the effect of light, temperature, osmosis, etc. It may be safely stated that the experimental conditions at Lawrence are a hundred-fold more severe than would ever occur in the filtration of an ordinary water supply. This shows what a large factor of safety lies behind the bacteriological investigations at the Lawrence Experiment Station, and, furthermore, may serve to explain the confidence with which those who are familiar with these investigations believe in hygienic efficiency of the sand filtration of water supplies.

The results from the filtration of water at Lawrence are no longer confined to the experimental stage. A filter to purify the water supply of the city of Lawrence has been for the past year in successful operation (see Eng. News, Aug. 3, 1893).

From the time when the filter was put in operation, Sept. 20, 1893, until May 1, 1894, daily bacteriological analyses, in addition to numerous chemical analyses, were made of the water before and after its passage through the filter, as it leaves the reservoir and from taps at the City Hall and Experiment Station, which are distant 1.5 to 2.5 miles, respectively, from the reservoir. The results were as follows:

	Ave. No. of bacteria per cu. cm.	Ave. p. c. removed of number applied.
River	10,900	.....
Effluent at filter	264	97.58
Water from reservoir outlet	139	98.73
Water from tap at City Hall	90	99.17
Water from tap at Experiment St'n.	82	99.25

The above averages include all results. Excluding those results obtained under conditions which were abnormal and not likely to occur again, we find that this filter normally reduced the bacteria from 9,000 to 150 per cu. cm., a removal of 98.3% of the number applied. Owing to the fact that some ground water of somewhat unsatisfactory quality with regard to numbers of bacteria was at times mixed with the effluent, it is very improbable that all the bacteria in the water pumped to the reservoir passed through the filter.

During the five years preceding the use of the filter, the average annual death rate from typhoid fever in Lawrence was 1.27 per 1,000 inhabitants. The population of Lawrence is 50,000, and this average is equivalent to 63 actual deaths per year. During the past year there have been 26 deaths from typhoid fever, a reduction of 60%. Furthermore, it has been learned that of the 26 who died, 12 were operatives in the mills, each of whom was known to have drunk unfiltered and polluted canal water, which is used in the factories at the sinks for washing. Among the operatives of one of the largest corporations, where canal

Fig. 1 Plan Showing Canal of the Niagara Power & Development Co.

water is not used, there has not been a single case of typhoid fever during the past year.

The test of the efficiency of the filter during the past year has been a fair one, because at Lowell, the sewage of which enters the Merrimac River nine miles above the intake of the Lawrence filter, there was during the past winter a severe epidemic of typhoid fever.

In conclusion, we may state that it has been found practicable to protect the consumers of an infected water supply by means of sand filtration.

WATER-POWER CANAL FOR THE NIAGARA POWER & DEVELOPMENT CO.

In our issue of Nov. 24, 1892, we published a small map showing some of the schemes for developing the power of the Niagara River, which have been started during the past few years, while the great works of the Niagara Falls Power Co. have been under construction. The most prominent of these schemes has been that which was incorporated by the New York legislature in 1891, and which contemplated the taking of water from the Niagara River at a point some five miles above the falls, and carrying it by a canal or tunnel due south to the Niagara escarpment, and thence back to the river, at a point near the city of Lewiston.

To carry out this plan, a company known as the Niagara Power & Development Co. was organized, and, as was recently noted in these columns, has been asking for proposals for building its canal, the bids closing on Oct. 1. It is the intention of those at the head of the enterprise to build a manufacturing city on a site near the present city of Lewiston, and control of a large tract of land has been secured with that in view.

The accompanying map, profile and cross-sections show the extent of the work which the company has undertaken to secure the desired water-power. According to the specification, the canal will be about 40,000 ft. long and 40 ft. wide at the bottom, with a 1 to 1 slope in earth, and a 1 to 10 slope in rock. The earth to be excavated is mainly clay, with some gravel, and the rock is chiefly limestone. The contractor on each section will be expected to remove an average amount of not less than 2,000 cu. yds. per day. The water line is about 18 ft. above the bottom in earth, and about 25 ft. in rock. The amount and kind of material

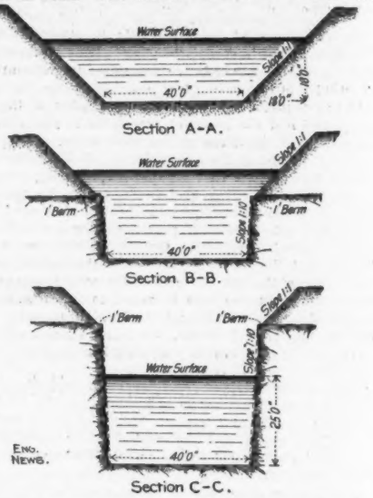


Fig. 3. Cross Sections of Water Power Canal.

to be excavated are shown approximately in the following table. The sections are each 5,000 ft. long.

Section.	Earth, cu. yds.	Rock, cu. yds.	Total, cu. yds.
1	321,000	4,000	325,000
2	220,000	118,000	338,000
3	114,000	340,000	454,000
4	148,000	503,000	651,000
5	104,000	918,000	1,022,000
6	102,000	802,000	904,000
7	125,000	759,000	884,000
8	184,000	770,000	954,000
Grand total	1,318,000	4,304,000	5,622,000

As shown by the plan, Fig. 1, the canal will extend from near La Salle, N. Y., on the upper Niagara, to below Lewiston, on the lower Niagara. The profile is shown in Fig. 2, while Fig. 3 shows the cross-sections of the canal.

The water is intended to have a velocity of 5 ft. per second in the canal. This volume of water, at 80% efficiency, will generate about 100,000 HP. at the cliff fall of 210 ft., and about 38,000 more at the river fall of 80 ft. Most of the canal below the water line is in rock, and the remainder is in a very stiff clay and hardpan, which it is thought will stand with a 1 to 1 slope, even with a current of 5 ft. per second flowing through it. It was at first intended to build a tunnel instead of an open cut in the last four miles of the upper canal, but a geological examination of the country developed the presence of the Niagara shale along nearly the

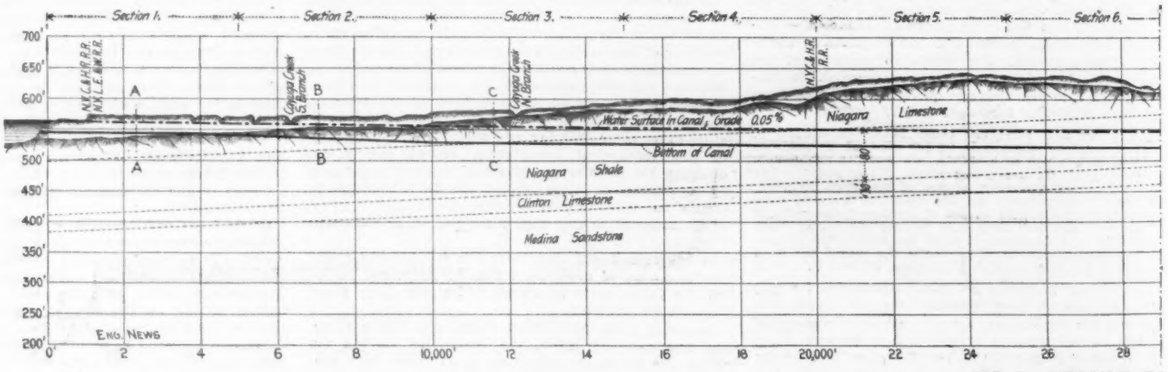


FIG. 2. PROFILE OF

whole length. This shale is identical with that through which the tunnel of the Niagara Power Co. passes, and therefore it would be necessary to line it throughout its length. This, together with the increased size of both canal and tunnel, made necessary to compensate for the loss of head that would follow at the cliff, led the company to abandon the idea of the tunnel.

The company expects to group a few heavy users of power at the foot of the cliff, and let them use the power directly from the wheels, but the main portion of it will probably be distributed electrically from one power house to factories built at various points on the adjacent plain. It is the present intention of the company to use most of the power on the ground, rather than to transmit it to other places. For this purpose it has secured control of about 25 sq. miles of land, taking in most of the plain stretching from the cliff to Lake Ontario, and proposes in time to develop a manufacturing city there.

The material in the lower canal is mostly earth and soft shale, and the amount of excavation is small, so that this portion will probably not be let before next spring. The material taken out of the last four miles of the upper canal will be piled upon the bank, and all rock suitable for concrete or building purposes will be made available by means of a railway, which will be built along the line of the canal from La Salle to Model City.

Mr. E. C. Reynolds is the Chief Engineer of the Niagara Power & Development Co., and Mr. Geo. B. Burbank, M. Am. Soc. C. E., late Chief Engineer of the Cataract Construction Co., is Consulting Engineer. We are indebted to Mr. Reynolds for the drawings and information from which this article is prepared.

Fig. 1 Computer for Rectangular Beams.

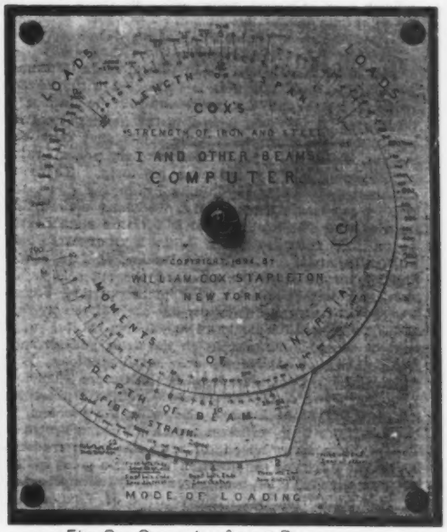


Fig. 2. Computer for I-Beams.

MECHANICAL COMPUTER FOR THE STRENGTH OF BEAMS; Designed by Wm. Cox.

COX'S MECHANICAL COMPUTERS FOR PROPORTIONING BEAMS.

We illustrate herewith two very ingenious mechanical computers, designed by Mr. William Cox, of Stapleton, N. Y., for figuring the strength of beams. The one shown in Fig. 1 is designed for computing the strength of rectangular beams, while that shown in Fig. 2 is for I-beams.

Each of these computers consists of a foundation plate, having a clearly graduated outer circle, within which revolves a disk similarly graduated on its outer edge. These graduations are scales which represent a wide range of values of certain of the factors of the formulas whose solution the computers are designed to give. At the bottom of each instrument is a revolving arc, having likewise graduated scales on its edges, which are used in combination with the scales on the disk and on the lower part of the plate.

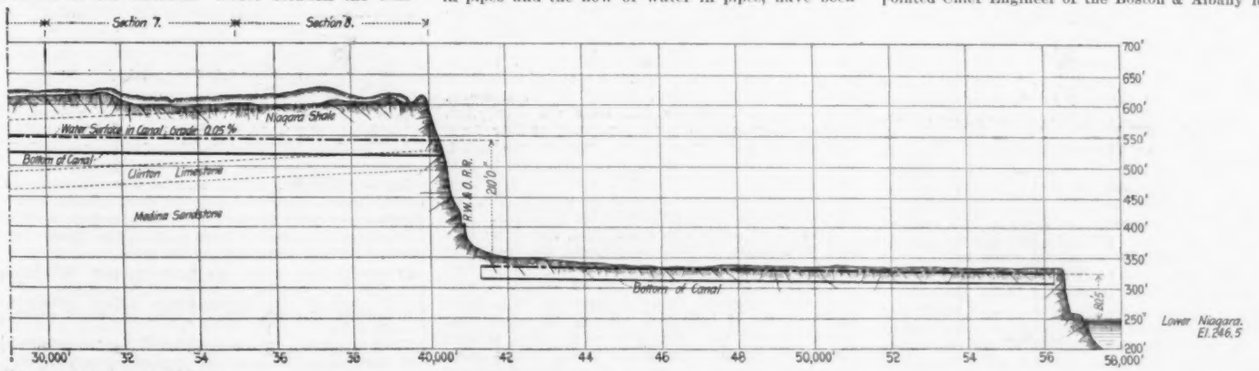
The computer for rectangular beams gives at sight the breaking load, or the safe load with any factor of safety, for beams of any dimensions within the range of practice, and suitable breadths and depths of beams may be at once selected for any load and span of beam.

The computer for I-beams gives the safe load for any beam with any fiber strain, and also inversely, the moment of resistance or the moment of inertia and the depth of beam for any given load and span of beam.

These results may be obtained at sight for eleven different kinds of loading. The computers may, however, be also equally well applied to those numerous cases of beams loaded at irregular points with irregular loads, all that is required being to ascertain the bending moment of the beam in foot-tons, from which the moment of resistance or the moment of inertia and the depth of the beam in the one case and the depth and breadth of a suitable rectangular beam in the other are at once read.

These computers are mounted on a substantial board, 12 × 14 ins., and are provided with a brass center and nut for locking the different scales in any desired position. The manipulation is exceedingly simple, and the results, although obtained with such despatch, may be fully relied upon, being obtained with far less liability to gross error than is the case when the computation is performed arithmetically.

Previous computers of somewhat similar form, designed by Mr. Cox for figuring the flow of gas in pipes and the flow of water in pipes, have been found of great advantage in offices where such computations must be frequently made. The computer for the flow of water was illustrated and described in our issue of Dec. 22, 1892. The beam computers illustrated herewith, however, excel in ingenuity anything which Mr. Cox has previously designed in this line, and will be found a great convenience in many engineers' and architects' offices.



WATER POWER CANAL.

The use of aluminum, as a means of reducing the weight of military equipments, is being investigated by the U. S. Ordnance Bureau. The Germans have already adopted it for many uses in their army. The samples now sent to the Ordnance Bureau, at Washington, include aluminum cups, belt buckles, hooks and horseshoes. Among other adaptations proposed for this new metal are bayonet-scabbards, dishes and other articles in which strength is not an important requisite.

PERSONALS.

Mr. Courtenay De Kalb, mining engineer, has been appointed Professor of Mining and Metallurgy in the University of Missouri, at Rolla, Mo.

Mr. H. T. Wilson, formerly City Engineer of Galveston, Tex., has been appointed Chief Engineer of the water-works improvements at Galveston.

Mr. Willard A. Smith has been appointed honorary curator of the transportation division of the department of industrial arts at the Field Columbian Museum, of Chicago.

Mr. J. A. Atwood has been appointed principal Assistant Engineer of the Pittsburg & Lake Erie R. R., and the office of Engineer of Construction has been abolished.

Mr. F. E. House has been appointed Chief Engineer of the Pittsburg & Lake Erie R. R., with headquarters at Pittsburg, Pa., and the office of Engineer of Maintenance of Way has been abolished, its duties being performed by Mr. House.

Mr. Walter Shepard, of Boston, Mass., has been appointed Chief Engineer of the Boston & Albany R. R., vice Mr. W. H. Russell, who has occupied that position for 36 years. The position of Consulting Engineer has been created for Mr. Russell.

Mr. Wallace Harlow Dodge, M. Am. Soc. M. E., President of the Dodge Mfg. Co., Mishawaka, Ind., died Sept. 10, at the age of 45. He was an inventor and manufacturer of prominence, especially in connection with wooden pulleys and rope power transmission.

Mr. Geo. W. Rafter, M. Am. Soc. C. E., of Rochester, N. Y., sailed on Sept. 29 for a European tour of two or three months. During his stay abroad he will examine the types of canal bridges in use in the principal countries of Europe on behalf of the canal authorities of New York, who are desirous of securing some improved type of lift or swing bridge for use on the New York State canals. Mr. Rafter will also examine some of the principal high masonry dams of Europe.

Mr. Isaac V. Baker, who died at Comstocks, N. Y.,

Sept. 27, at the age of 82, was for some years General Superintendent of the Troy & Boston R. R., and afterward General Manager of the Rensselaer & Saratoga R. R. and its leased branches, which position he held some time after its lease to the Delaware & Hudson Canal Co. in 1874. He built for the Delaware & Hudson the New York & Canada R. R. and became its president. For the past few years he had retired from railway service.

NEW PUBLICATIONS.

OCTOBER MAGAZINES.—In this month's "Forum," Mr. H. T. Newcomb, who is connected with the Bureau of Rates and Transportation of the Interstate Commerce Commission, writes on the topic, "Can Railway Rates be Cheapened?" He holds that they can be—not, however, by further reducing the present rates of dividend, but by reducing expenses. There is abundant opportunity to do this by cutting down the staff of the traffic departments, abolishing unprofitable train service and loading cars and trains more nearly up to their capacity. Prof. R. T. Ely, of Wisconsin University, and Prof. Arthur T. Hadley, of Yale, representing, respectively, the new and the old schools of political economy, discuss what place practical socialism should be given among us; but each of the writers seems to be a little afraid to handle his subject properly. A much better article on the same general subject, but with more reference to social problems, is a paper on "The Contented Masses," by Octave Thanet.

In the "North American Review" we find a paper by the Lord Mayor of London, discussing the problem of the best form of government for that great metropolis. The paper is of especial interest to American readers, because it discusses the question whether a great center of population can be best governed by a number of local organizations, like the vestries of London, or whether a single centralized government is preferable. The Lord Mayor inclines to the former view, and quotes Mr. Joseph Chamberlain's statement that even the smaller English cities, like Birmingham, are growing so large that it will be impossible for them to remain under a single system of self-government. He points out that the municipal expenditures are far higher in Paris and in New York than in London, reaching in New York the enormous sum of $22 per capita per annum, and continues:

> New York and Paris proclaim with warning voice that the biggest things in local government are not very different from the biggest failures.

Another paper in the same magazine is by the Assistant Secretary of the Navy, Hon. Wm. McAdoo, explaining the plans which are now under consideration by a Congressional Commission for the reorganization of the Navy. Another paper which deserves more prominence than it receives discusses the need of greater use of professional accountants as a means of securing a more honest administration of the affairs of large corporations.

"Scribner's" leading article is a most entertaining paper by Col. H. G. Prout, Editor of "The Railroad Gazette," entitled "Railroad Travel in England and America." It might naturally be supposed that there was absolutely nothing new to be said on this threadbare topic; but, new or old, Col. Prout has contrived to make some most interesting comparisons and to write a paper which combines a good deal of literary merit with some information that is worth the having, and a little criticism that might be studied to good advantage by railway managers on both sides of the water. According to his figures, a passenger in the United States runs about 4½ times the risk of being killed that he does in Great Britain. He pays less and gets more for his money if he does all his riding in Pullman or Wagner cars than he would pay if he traveled first-class in Great Britain. On the other hand, if he travels with the bulk of his fellow-men in good democratic style he can ride a given distance for much less money in England. As for rates on excursion and special tickets, they are far lower in England than here, largely on account of the far greater volume of traffic. America has the fastest trains in the world, thanks to the officers who have their headquarters at the Grand Central station, but there are more trains in England than here that run at speeds of 40 miles an hour and upward, including stops; or rather there were some six or seven years ago. It is not unlikely, we think, that a record taken now would show a somewhat different result. As for relative comfort, it appears to be the case that each system has "its good pints and its bad pints," and each suits better than would the other the nation that it serves.

In the "Review of Reviews" Mr. Wm. E. Smythe, Chairman of the National Committee chosen at the recent Irrigation Congress, has a brief paper entitled "The Progress of Irrigation Thought in the West," which is really a review of the work done by the recent convention.

In "The Century" we find a finely illustrated article on the teak-wood industry in Burmah, and the departments contain some interesting matter concerning the recent railway strike and the general relations between employer and employee.

CITY GOVERNMENT IN THE UNITED STATES. By Alfred R. Conkling, formerly Alderman of the City of New York, and Member of Assembly of the State of New York. New York: D. Appleton & Co. 12mo, cloth; pp. 227. $1.00.

The motto adopted by Mr. Conkling on his title page is that "Municipal government is business, not politics," and upon these lines this "primer" of the science of city government is written. The author first takes up the general subject of the control of American cities and then treats in separate chapters of the Mayor, the aldermen, the various departments, finance and taxation, elections, and finally suggests remedies for the evils pointed out. Mr. Conkling has made a close study of the literature of municipal government and has enlisted in the service the heads of many of our chief cities and his personal friends. As the author explains, the defects in our municipal governments are largely the result of the phenomenally rapid growth of our cities, coupled with the ignorance, carelessness and want of foresight of their rulers. In 1789, when the United States may be said to have had its beginning, only 3% of the total population lived in cities. In 1800, 4% resided in cities having a population exceeding 8,000; in 1860, 16% resided in 141 cities of this class, and in 1890, 29% of the entire people lived in 437 cities having a population of 8,000 or over. In 1894 we find nearly 10% of the entire population living in four large cities of the United States. This rapid increase in urbane population shows the importance of good city government, for if these cities are well governed it is evident that about one-third, at least, of the people of the whole country would be well governed.

Mr. James Bryce in his "American Commonwealths" gave two tests of practical efficiency in the government of a city: "What does it provide for the people?" and "What does it cost the people?" This cost is usually measured by the rate of taxation; and Mr. Conkling here points out how the rulers of New York, for some years past, have been enabled to show a nominally low tax rate by simply increasing the assessed valuation of realty and personal property each year by sums ranging from $70,000,000 to $105,254,253, in 1893. The unthinking freeholder, in the newer parts of the city, especially, pays a really higher aggregate of tax each year, though his tax-rate is "low." The subject of exorbitant salaries paid to city officials is one that needs sharp watching; and particularly so in the case of subordinates whose pay is often absurdly out of proportion to their real services. Mr. Joseph Chamberlain, in an article on municipal institutions in America and England, compares his own city, Birmingham, with Boston, which has about the same population, and is also largely a manufacturing town. He finds that the total annual municipal expenditure, excepting appropriations for schools and almshouses, is $1,665,000 for Birmingham as compared with $10,194,000 for Boston. He ascribes this enormous disproportion between the cost of similar municipal services largely to extravagance, born often of deliberate dishonesty and corruption. Berlin, with about the same population as New York, and one of the best governed cities in the world, spends each year but one-half the sum that is paid out for New York government; and even admitting that rent and wages are lower in the German city, this item alone is far from explaining the difference.

In taking up our several great cities, the author says that Washington is, in some respects, the best ruled of all our cities; and this is due chiefly to the fact that it is the national capital and all legislation emanates from Congress. Under the previous "Boss Shepherd" regime of individual control, its government was notoriously bad. The most unique form of local government is that of Memphis, Tenn., which, under the law of 1879, has no charter in the proper sense of the word. It is a combination of "taxing districts," with officers under bonds over each and the President of the Board of Fire and Police Commissioners is elected as executive officer and is responsible for the enforcement of the laws. There was originally no Mayor, though the President referred to now bears that title. The Legislative Council of the taxing district is made up of the Fire and Police Board Commissioners, the Supervisors of the Board of Public Works and the Board of Health. This peculiar form of government has given much satisfaction. In discussing the method of appointment or election of the Mayor of a city, Mr. Conkling makes one suggestion that would not be popular among local politicians. It is, that any good man who has made a satisfactory record as Mayor of Buffalo, for example, should be eligible for election as Mayor of New York. This is the German practice, where a Mayor can come from any city; just as the present Mayor of Berlin is a citizen of Magdeburg and first proved his capacity as Mayor of that city. The great desideratum in American cities is the selection as Mayor of a competent, honest, fearless man, says Mr. Conkling; but a Mayor of this type is just the man who is not wanted by the "boss," who usually controls the dominant political faction or party.

Mr. Conkling takes up the various city departments in a similar manner and compares them in cost to the people and in efficiency of method to similar bureaus in European cities, very much to our disadvantage. As a check to enormous cost in public buildings he would spend no money on their decoration; making them "plain, durable and of the best material only." But he acknowledges that in European cities the public buildings are generally artistic in design, and in many cases are gems of architecture. Space does not permit our going more fully into the chapters on department organization and taxation, city debt, etc., but the author, in conclusion, says, as many have before said, that the introduction of an intelligent and independent method of voting at city elections is the chief remedy for the many evils and corrupt practices pointed out in his work. In other words, elect the proper class of men as rulers and the ruling will improve. To prevent false registration, Mr. Conkling would introduce the San Francisco plan of passport registration, with age, height, weight, color of eyes and hair, complexion, etc., fully noted on the registry books. The next step would be to require voters to write their names when registering, for the purpose of later identification at the polls. And if this regulation requires the voter to read and write, his vote is probably more intelligent and better represents himself for this reason. He also approves of a low property qualification. The thing to be done, and it will take time, says our author, is to teach voters that they can support the best man at a city election without renouncing allegiance to a national party. Naturalization laws should be amended so as to do away to some extent with the use of the ignorant foreign vote for purely corrupt purposes. Mr. Conkling recprevailing in Massachusetts, Connecticut, Wyoming and Mississippi; the failure to vote is denounced and the Kansas poll-tax of $2.50, which may be annulled by voting at a separate city election, seems to have some merit. As a very first remedy the author would incorporate all cities under a general law, classified by population, and all amendments of city charters by special acts, passed without the knowledge or consent of the voters of the city, should be prohibited. The general law should equally apply to all cities of each class. And finally Mr. Conkling truly says that the average American citizen is too patient and long-suffering in enduring municipal abuse. He is advised to take a lesson from his English cousin and learn to "kick," and kick vigorously. The everlasting tendency of the Briton to complain and insist upon his right to good government, even in small things, has doubtless a strong effect upon the methods of those selected to rule English cities, and accounts to some extent for their more efficient and economical government.

MISSOURI ROAD IMPROVEMENT JOURNAL. A monthly magazine devoted to the improvement of roads and streets. Published by authority of the Missouri Roads Improvement Association. Levi Chubbuck, Secretary, Kidder, Mo. Vol. I., No. 1, August, 1894.

This is the latest publication issued in the interest of road improvement. The first number is modest in appearance, and is chiefly devoted to publishing the reports of road conventions held in that section and announcing those to come. But as the Missouri Association is young yet, having held its first convention in 1892, there is plenty of time for development. Meanwhile every effort of this kind is doing a good work in spreading the gospel of good roads among those who must ultimately build and pay for them.

SYNOPSIS OF THE PATENT LAWS OF THE WORLD. By John P. O'Donnell, M. Am. Soc. C. E., M. Inst. M. E., Patent Agent. Palace Chambers, London, England. 12mo; paper; pp. 87; 1 shilling (25 cts.).

This is a very useful compilation giving the substance of the patent laws of the various countries, with charges, regulations as to trade-marks, and other information. A summary is given of the British laws on patents and trade-marks, with particulars as to renewal fees, oppositions, etc. There is also given an abstract of the international convention for the protection of industrial property, signed at Paris in 1883. The book is a handy reference book for inventors and patent attorneys.

TRADE PUBLICATIONS.

TEMPERATURE REGULATION. Johnson Electric Service Co., Boston, Mass. 12mo; pp. 40; illustrated.

This pamphlet is descriptive of the Johnson system of temperature regulation for dwellings, offices, schools, hospitals, etc. Different rooms can be kept at different temperatures, and any desired degree of temperature can be maintained. A thermostat in each room (which can be adjusted to the desired degree) is connected to an electro-pneumatic valve which controls the compressed air used as the medium for operating the heater valves and dampers. A list is given of a large number of public and private buildings equipped with this system.

SOCIETY PROCEEDINGS.

WESTERN SOCIETY OF ENGINEERS.—The regular monthly meeting of the society was held at the Grand Pacific Hotel Oct. 3. Two papers were presented: "Notes on a Broken Pinion Shaft," by Mr. Onward Bates, M. Am. Soc. C. E., Engineer of Bridges, C., M. & St. P. Ry.; and "General Hydraulics of Chicago Main Drainage Channel, Effect on the Lakes, Des Plaines, Illinois and Mississippi Rivers, etc.," by Mr. Thos. T. Johnston, Principal Assistant Engineer. On Oct. 6 the second excursion of the society along the Drainage Canal will be taken, the visit being made to sections E to A and 1 to 8, comprising the middle portion of the canal.

AMERICAN SOCIETY OF RAILROAD SUPERINTENDENTS.—The 24th meeting will be held at the Hotel Brunswick, New York city, on Monday, Oct. 15, 1894, at 10.30 a. m. Mr. Willard A. Smith of Chicago, Honorary Member, late Chief of the Department of Transportation, World's Columbian Exposition, will deliver an address on the subject of "Railway Education." The following reports of standing committees will be presented: "Roadway," D. B. McCoy, chairman; "Machinery," J. F. Divine, chairman; "Transportation," F. K. Huger, chairman, and "Signalling," W. G. Wattson, chairman.

The following topics for discussion are also to be considered:

1. Is there sufficient reason for discontinuing the use of white or clear light as a safety signal in American railway practice? If so, what color can be substituted to mean "safety," and what to mean "caution"?

2. What principles are to be recommended for fixed signals, especially for block-signals and interlocking, that will promote uniformity in installation, simplicity in operation and clearness in signification?

3. Is the use of derailing switches in terminal yards to be recommended?

4. What principles and methods have been found, in your experience, most effective, in order to obtain trained, reliable and loyal employees in the operating department?

5. Experience in the application of the Standard Code of Train Rules in cases of doubt or difficulty.

6. Special instances of economy in the handling of freight service.

C. A. Hammond, Secy.

AMERICAN PUBLIC HEALTH ASSOCIATION.—The annual meeting of the association was held at Montreal, Sept. 25 to 29, inclusive. A large number of papers were scheduled, many of which related to sanitary engineering. Among these may be mentioned by title, merely, the following: "Observations Upon Sedimentation in Water," by Dr. Wyatt Johnston, Bacteriologist to the Board of Health of the Province of Quebec; "The Long Island Water Basin," by A. N. Bell, M. D.; "Pure Water vs. Purified Water for Public Water Supplies," by Daniel W. Mead, Rockford, Ill.; "Water Supply of Towns," by Dr. A. P. Reid, Secretary of the Provincial Board of Health of Nova Scotia; "Report of the Committee on the Pollution of Water Supplies," by Dr. Charles Smart, Major and Surgeon, U. S. A., chairman; "Drainage of Montreal," by Alfred Brittain, Assistant Surveyor of Montreal; "Car Sanitation," by Dr. James Patterson, Chairman Provincial Board of Health of Manitoba; "Report of Committee on Car Sanitation," by G. P. Conn, M. D., Concord, N. H., chairman; "Mechanical Ventilation," by Rich. Fleming, Engineer to the Montreal Sanitary Association; "Sanitary Value of Certain Waters," by Dr. R. F. Ruttan, Chemist to McGill University, and to the Board of Health of the Province of Quebec.

A verbal report on the "Disposal of Garbage and Refuse" was made by Mr. Rudolph Hering, M. Am. Soc. C. E., as chairman of a committee on that subject. Mr. Hering reviewed the various systems of disposal and will write a report later for publication in the proceedings of the association. Dr. N. E. Wordin, of Bridgeport, Conn., was scheduled for a paper on the same subject. Col. W. F. Morse, of the Engle Sanitary & Crematory Co., New York city, read a paper on the same general subject, but with especial reference to the garbage and refuse problem in New York city. The following is a brief abstract of Colonel Morse's paper:

The number of cart loads of various kinds of garbage and waste collected in New York in 1893 is given as follows:

Mixed ashes, refuse and garbage, collected by Street Cleaning Department	1,089,400
Street sweepings	305,755
Market wastes	10,368
Department Public Works, Parks and Docks	24,949
From manufacturers	276,151
Total collections	1,706,632

Nearly all of this was either sent to sea or put behind bulkheads, some 85,000 loads only having been used for filling. The street sweepings and wastes from the departments of public works, parks and docks, and from manufacturers, Mr. Morse thinks, contain no putrescible matter. There remains, then, some 1,100,000 cart loads which contains objectionable matter, although he estimates that 80% of this is incombustible. Taking the wastes as a whole, it is thought that their composition is about as follows:

	Per cent.		Per cent.
Ashes	59	Garbage	12
Street sweepings	24	Ice and snow	2
Total			100

New York derives some $90,000 a year from contractors for the privilege of trimming the garbage scows, from which rags, bones, metal, glass and various other materials are obtained. Possibly this work might be done with more system and profit.

The garbage and other refuse is now collected from 58 districts, from an area 16 miles long by 2 miles wide, and conveyed in carts to 16 separate dumps, scattered along a water front of some 28 miles. These dumps are designed to be so located as to divide the total wastes pretty equally among them.

Assuming 700 loads per day of all classes of material as the maximum brought to one of the city dumps, and allowing that 250 loads of this would not need treatment, there would remain 450 loads of some 42 cu. ft. each, or a total of 700 cu. yds. to be disposed of at each of the 16 dumps. This, it will be understood, is based on the greatest daily amount of waste at the dump which receives the largest amount of refuse.

On the basis of 700 cu. yds. per day as a maximum, Mr. Morse proceeds to outline the plans for a plant for receiving and sorting the wastes, despatching inoffensive matter by dumping scows and burning the balance, of course saving all the metal and other salable products of the sorting. Petroleum would be used as fuel, and perhaps 13 crematories would answer, all located on the water front.

A paper on the "Sand Filtration of Water," read by Mr. George W. Fuller, of Lawrence, Mass., is given nearly in full in another column. A paper describing some bacteriological studies of the water supply of Toronto, as taken from Lake Ontario, was prepared by Prof. Shuttleworth, and read by Mr. Fuller. This paper is given in full elsewhere in this issue.

WESTERN RAILWAY CLUB.—At the meeting of Sept. 18 the report of the Committee on Shop Tests of Locomotives was read by Mr. Willard A. Smith. The report stated that this committee had co-operated with a similar committee of the American Railway Master Mechanics' Association, and as a result of that committee's report the association had appointed two committees; one to consult with the American Railway Association regarding the appropriation of sufficient money by the railways to carry out the tests, and the other to prepare careful plans for such tests. This last committee had completed its work and would make its report at the proper time. The committee appointed to consult with the American Railway Association expected to meet the officers of that association on Sept. 20, and confer with them regarding the proposed work, and that the results of this conference would be reported upon later. The report then asked that the committee of the Western Railway Club be discharged. The committee was discharged upon the vote of the meeting.

Some discussion then followed upon the place of meeting of the club for the current year, it being finally voted that the club should not meet again in the Y. M. C. A. rooms, and also that the executive committee confer with the Western Society of Engineers and the Society of Electrical Engineers with a view of securing a permanent place of meeting for the three societies.

The discussion of the subject of Interchange at Chicago was then formally opened by Mr. J. N. Barr. Mr. Barr stated that the Chicago, Milwaukee & St. Paul Ry. had about twice the number of car inspectors at Chicago per car inspected as it had at any other point on its line, and he believed that this was true with the other railways entering Chicago. The inspection was carried on under the protective system; that is, the inspection was made not to see that the car was safe to run, but to protect the company receiving the car from any damage to, or improper condition of, the car when received. For this reason many cars which had only a slight defect, and which were perfectly safe to run perhaps for months, were held until a defect card was secured from the owners. This occasioned much useless delay in traffic and often heavy switching charges. He thought the solution for this was to treat quite a large number of defects, if not the whole car, precisely as wheels and axles were now treated; that is, for the road receiving the car to make the necessary repairs and bill against the owners for these repairs, certifying, of course, that the damages were not caused by derailment or wreck. He considered that such an arrangement could be advantageously entered into by the railways entering Chicago.

Mr. Peck stated that he considered that the plan proposed by Mr. Barr was a move in the right direction. In 1891 he took some trouble to find out some facts about the interchange work at Chicago. He found that the number of inspectors was 256, and of car repairers, 1,463; the total number of men kept on interchange work thus being 1,719. The number of cars repaired daily was 1,076, and of cars transferred, 5,629; average number of cars inspected daily for one man, 39; cost per car, .0425 cts. The daily receipts of cars were 10,060. There was no road that wanted to get out of paying for cars that they broke; it was for cars that they did not break. If the inspectors saw a defect they must make a record of it; if they did not, some one would find it and report them, although the car might run 10 years and no harm come of it. He had known cars to run several years after a defect had been reported on them.

Mr. Waitt agreed with Mr. Barr. For some time the Lake Shore & Michigan Southern R. R. had had an agreement similar to the one proposed with several of their connections. The cars were inspected for safety only. This had resulted in a saving of 50% in inspection at interchange points, the mileage had been increased, and there had been a reduction of at least 25% in the time taken in getting the cars over the line.

Mr. Potter thought that while theoretically Mr. Barr's plan would probably be all right, that practically it would not work. Before such an arrangement could be put in operation at Chicago, he thought that the company's other connections would have to be consulted; in other words, all companies whose cars a Chicago road received would have to become parties to the agreement. As he understood the proposed plan, it did not expect to save anything in the way of inspectors, and as for delay in traffic on account of inspection, he had not heard of any serious complaint. The only benefit he could see from the plan was that cars would not be repaired and charged for when they had only slight defects.

Mr. John Mackenzie stated that he considered that the plan would be a detriment and not an advantage. There were many roads which, under the plan, would take off their car repairers and never do anything for the cars, and the consequence would be that the other roads would have to repair everybody's cars. A further consequence would be that the cars would rapidly deteriorate.

After some further discussion it was voted that a committee be appointed to draw up a code of rules and an agreement between the Chicago roads on the basis proposed by Mr. Barr. The committee appointed consisted of J. N. Barr, A. M. Waitt and John Mackenzie.

Mr. E. M. Herr then read a paper entitled "Notes and Impressions of European Railway Practice." At the October meeting Mr. A. M. Waitt will read a paper entitled "The Present Status of the M. C. B. Coupler."

COMING TECHNICAL MEETINGS.

ENGINEERS' CLUB OF PHILADELPHIA.
Oct. 6. Secy., L. F. Rondinella, 1122 Girard St.
WISCONSIN POLYTECHNIC SOCIETY.
Oct. 8. Secy., Geo. G. Mason, 144 8th St., Milwaukee.
ENGINEERS' CLUB OF KANSAS CITY.
Oct. 8. Secy., Waterman Stone, Baird Building.
NORTHWEST RAILWAY CLUB.
Oct. 9. Secy., W. D. Crosman, Ryan Hotel, St. Paul.
NORTHWESTERN SOCIETY OF ENGINEERS.
Oct. 9. Secy., D. W. McMorris, Burke Blk., Seattle, Wash.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
Oct. 9, 11. Secy., F. C. Osborn, 721 Hickox Building.
DENVER SOCIETY OF CIVIL ENGINEERS.
Oct. 9. Secy., F. Ed. King, 36 Jacobson Block.
NEW ENGLAND RAILROAD CLUB.
Oct. 10. Secy., F. M. Curtis, P. O. Box 1576, Boston, Mass.
ENGINEERS & ARCHITECTS' CLUB OF LOUISVILLE.
Oct. 11. Secy., G. W. Shaw, Norton Building.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
Oct. 11. Secy., C. H. McLeod, 112 Mansfield St. Montreal.
ENGINEERING ASSOCIATION OF THE SOUTH.
Oct. 11. Hunter McDonald, Nashville, Tenn.
MONTANA SOCIETY OF CIVIL ENGINEERS.
Oct. 13. Secy., G. O. Foss, Helena, Mont.
ENGINEERS' CLUB OF INDIANAPOLIS.
Oct. 13. Secy., C. C. Brown.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
Oct. 14. Secy., D. W. Meeker, St. Paul, Minn.
ENGINEERS' CLUB OF MINNEAPOLIS.
Oct. 15. Secy., E. Nexsen, Kasota Block
ASSOC. SUPERINTENDENTS OF BRIDGES & BUILDING.
Oct. 16. Kansas City, Mo. Secy., S. F. Patterson, Concord, N. H.
WESTERN RAILWAY CLUB.
Oct. 16. Secy., C. F. Street, Rookery Building.
COLUMBIAN ENGINEERING SOCIETY.
Oct. 16. Secy., F. W. Hart, Washington, D. C.
AMERICAN STREET RAILWAY ASSOCIATION.
Oct. 17. Atlanta, Ga. Secy., Wm. J. Richardson, Brooklyn, N. Y.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
Oct. 17. Secy., J. H. Pilcher, Roanoke, Va.
BOSTON SOCIETY OF CIVIL ENGINEERS.
Oct. 17. Secy., S. E. Tinkham, 36 Bromfield St.
AMER. SOCIETY OF RAILWAY SUPERINTENDENTS.
Oct. 15. New York. Secy., C. A. Hammond, 32 Liberty St.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Oct. 17. Secy., Francis Collingwood, 127 E. 23d St., N. Y.
ENGINEERS' CLUB OF ST. LOUIS.
Oct. 17. Secy., W. H. Bryan, Turner Block.
ENGINEERS' CLUB OF CINCINNATI.
Oct. 18. Secy., J. F. Wilson, 24 W. 4th St.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
Oct. 18. Secy., D. Carhart, Carnegie Library Building, Allegheny.
NEW YORK RAILROAD CLUB.
Oct. 18. Secy., John A. Hill, Temple Court, N. Y. City.
CENTRAL RAILWAY CLUB.
Oct. 24. Secy., S. W. Spear, East Buffalo Iron Works, Buffalo, N. Y.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
Nov. 2. Secy., O. Von Geldern, 719 Market St., San Francisco.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Nov. 5. Secy., C. L. Annam, City Engineer's Office.
WESTERN SOCIETY OF ENGINEERS.
Nov. 7. Secy., Thomas Appleton, Lakeside Bldg., Chicago.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Nov. 15. Atlanta, Ga. Secy., F. A. Charpiot, Macon, Ga.
SOCIETY NAVAL ARCHITECTS & MARINE ENGINEERS.
Nov. 15 and 16. Annual Convention in New York city. Secy., W. L. Capps, U. S. N., Washington, D. C.
AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
Dec. 3 to 7. Secy., F. R. Hutton, 12 W. 31st St., New York.

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CHICAGO OFFICE: 1,636 The Monadnock.
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Our attention has been called to the fact that in our issue of Sept. 27, in commenting on Toronto's experience in owning and leasing its street railways, we omitted to mention the transfer feature. Under the specifications framed by Mr. W. T. Jennings, M. Am. Soc. C. E., late City Engineer of Toronto, when the lines were leased, free transfers were required on tickets or fares whenever desired by the passengers, and this feature was made part of the contract under which the lines are operated.

In another column of this issue will be found a summary of the current discussion in the American Society of Mining Engineers over the question whether a crystalline structure is caused in iron or steel by mechanical vibration. It deserves careful reading by every one of our readers who still believes the old theory that continued vibration will in time change fibrous wrought iron to a coarsely crystalline and brittle metal. It should be plainly understood that this is and always has been a theory merely; and notwithstanding the very general credence it at one time received, positive proof of its truth has never been furnished. On the other hand, it is of course true that it is well nigh impossible to bring evidence to prove that it is always and everywhere false. A correct statement of the position of the most reliable investigators on this question would be that while they do not deny the possibility that crystallization by vibration may yet be proved to occur, they do hold that the great mass of experimental evidence goes to show that so long as iron and steel are not strained beyond the elastic limit, their molecular structure will not be altered by either shocks or vibration.

We alluded recently to the fact that the best way to remove the friction and ill-feeling between capital and labor was by teaching working men that their interests and those of their employers are very largely identical; and this teaching can be done by the public press better than in any other way. It is equally true, on the other hand, that much of the underlying enmity toward capital on the part of labor has been bred by constant and wholesale lying. We happen to come across, in the "Railway Trainmen's Journal" for August, a good example of the way in which railway employees are lied to and misled. We quote the item verbatim, as follows:

> In round numbers it cost $4,000,000,000 to build and equip all the railroads in the United States. In round numbers their stocks and bonds amount to $12,000,000,000. There are $8,000,000,000 of this "watered" stock and bonds. The average interest on all this is 6%, or $480,000,000 annually paid. For what? It is not a debt. It is theft and robbery. This imposes a tax of 16% on the commerce of this country. Can anybody give a sensible reason for this government sitting calmly by and letting these syndicates and corporations wring $480,000,000 a year out of the people?

Now, we undertake to say that neither the writer of the above nor any other person in the world knows "what the railways of the United States cost in round numbers." And further, a man so ignorant as to suppose that all the watered stock in the corporations of the country pays 6% dividends, evidently has so little knowledge that his "guess" is of absolutely no account. It is not worth while arguing against his foolish assumption that two-thirds of the railway securities of the country are water; but it may be of interest to inquire just how far out of the way the second part of his statement is. Turning to the last issue of "Poor's Manual," we find that in the fiscal year 1893 the railways of the United States paid dividends amounting all told to $95,337,681. This was absolutely all that the owners of the roads received out of total gross earnings amounting to $1,222,618,290. The bulk of the earnings, of course, went to pay operating expenses, and some $245,000,000 went to pay interest on debts. Surely the anti-railway agitators do not object to the railways paying the interest on the money they have borrowed. We have never heard it claimed that railway bonds contained much water, except the tears that the owners of many of them have shed when a default occurred in the payment of their coupons.

The "Trainmen's Journal" credits this precious item to the "Alliance Herald," probably some organ of the "Farmers' Alliance," just where one would expect to look for this sort of thing. But the evil done by a railway employees' journal in printing such a preposterous lie is not a whit excused by the fact that it is taken from another journal. The editor of the "Trainmen's Journal" must know that such statements are veriest claptrap; he must have had the official statistics in his office which would show their falsity, and he knows, too, what lasting harm the circulation of such lies among his readers may do. If he has any regard for truth and for the best interests of the members of the organization, he will take pains to set his readers right on this important question.

That municipal government in American cities is not what it should be, is a lamentable fact; but that substantial reform can be reached on the lines laid down by Mr. Conkling in his work on city government, reviewed in this issue, is as yet a theory. It is a theory, however, that many would like to see put to the test of practice. Mr. Conkling constantly refers to the better and cheaper government of European cities; but it must be remembered that the conditions in Continental cities, at least, are very different from those here. The German Emperor, for example, practically controls the selection of the Mayor of Berlin, the city so often contrasted with New York as surpassing it in efficient and economic city administration, and the Prefect of the Seine, or the Mayor of Paris, is appointed by the Minister of the Interior. But we have no emperor, and, except in Washington alone, the national government has nothing to do with the control of municipal affairs. In our country the chief requisite for good city government is a thoroughly competent, independent mayor; one untrammeled by political or "boss" control, and whose duty it is to conduct affairs in a straightforward business way, and not on a political basis. As Mr. Conkling truly says, the proper conduct of municipal affairs "is business, not politics." But herein lies the weak spot in our system. As a rule the good citizens growl, complain of bad government and plan schemes for improvement; but they also, as a rule, fail to do their duty and exercise their privilege at the polls in electing the good men hoped for, and leave the professional politician to rule them and the city.

It all comes back, in our case, to the exercise of an intelligent, independent vote; the selection of the proper men, and the only hope for better administration lies in the direction of compelling the good citizens to do their duty and in making it as difficult as possible to utilize an ignorant vote for corrupt purposes.

The strength of the "boss" lies in the neglect of the legitimate citizen to exercise his rights, and until this neglect is corrected all else fails. There is too much sentiment and too little honest "business" in the accepted "republican idea," and the privileges granted wholesale to newly manufactured citizens of the United States. The ignorant vote, which can be bought and sold, is the capital of the "boss," and with it he controls the municipal, and, to a great extent, the state elections, for the purely selfish ends of the clique he represents. As long as the control lies in the hands of men who must reward their followers, we must expect extravagance and the selection of men chosen for other reasons than their fitness to rule the affairs of a great city. In a word, if the municipal business is to be conducted on the economic lines of a successful business corporation, every man connected with its administration must be selected for his especial fitness to perform his duty, regardless of political bent or party affiliations; and we regret to say that the day when this will be the case in our American cities seems far distant. The final advice of Mr. Conkling, to "kick" vigorously at all infractions of law, to complain constantly of all wrong doing, to expose fraud, to take pains to watch for it, and to actively work for better men and a better administration, seems to be the only way out of present difficulties. The effect of public exposure is now seen in the efforts of certain parties to at least reduce the corruption long existing in the police department of New York. But such exposure ought to go further and convict and sentence all known offenders. As is often said, the American citizen is too patient and long-suffering, and is too little aware of his own ability to correct the evils he complains of. But it would add much to his power if, as Mr. Conkling suggests, only those should vote at city elections who have educational, if not property, qualifications for so doing. Without these qualifications, the voter is invariably ruled by a question of immediate personal gain, or by the orders of his political masters, and either of these considerations ought absolutely to disfranchise him. Abolish the "boss" and elect the right kind of men as Mayor and members of the City Council, and the whole administration of city affairs will at once improve, at least so far as economical working is concerned. And the resultant increase in honesty and efficiency will be worth all it costs in some neglect of individual affairs and private business interests.

LIMITS TO THE PROFITABLE DEVELOPMENT OF WATER-POWER.

Our readers are familiar with the great work which has been carried out at Niagara Falls during the past five years, by which the waters of the Niagara River are to be made to turn wheels and develop power on a scale almost too enormous for comprehension. As our readers also know, the work of the Niagara Power Co., and of its offshoot, the Cataract Construction Co., has caused a number of similar schemes for power development to be started in the vicinity of Niagara; and, indeed, it is probable that it has had no small influence in attracting public attention to the value of water-power in general, in connection with electrical transmission, and thus has been a factor in causing the development of other long-unused waterfalls in different parts of the country.

Elsewhere in this issue will be found an illustrated description of another great enterprise which involves the development of power from the waters of the Niagara River, and on which actual construction is soon to commence. As there shown, the Niagara Power & Development Co., which has this enterprise in charge, proposes to cut an open canal, 40 ft. wide and about eight miles in length, beginning at a point on the Niagara River, about six miles above the great cataract, and running south and west to the Niagara escarpment, where it will fall a vertical distance of some 210 ft. From the foot of the escarpment a second canal is to run west to the Niagara gorge, which below the escarpment is comparatively shallow. A further fall of 80 ft. will be available at the gorge, however.

The enterprise which is here undertaken, if carried to completion, means even more power developed and more dollars expended than are involved in the Niagara Power Co.'s great work.

The tunnel which the Niagara Power Co. has driven from a point beneath its power house to the

river, below the falls, is capable of carrying the waste water from wheels generating about 125,000 HP. The canal, which the Power & Development Co. proposes will be capable of developing 100,000 HP. at the escarpment, and some 38,000 more at the gorge, assuming that 80% of the energy of the water can be utilized. In expenditure involved, the two works will probably show a much larger discrepancy. The tail race tunnel at the Falls is 7,250 ft. long, 14 to 16 ft. wide and 21 ft. high. The canal of the Power & Development Co. is to be 40,000 ft. long to the escarpment, and about 15,000 ft. long from the escarpment to the gorge. The profile shows a depth from the surface of the ground to the bottom of the canal averaging about 30 ft. for the first two miles, 65 ft. for the next two miles and about 100 ft. for the remaining four miles. At the deepest point on the line the bottom of the canal is to be 115 ft. below the surface of the ground. The slope chosen for the banks is 1 to 1 for earth and 1 to 10 for rock; on this basis the total estimated quantities to be excavated for the canal from the river to the escarpment are 1,318,000 cu. yds. of earth and 4,304,000 cu. yds. of rock. If we take the lowest ruling prices on the Chicago drainage canal contracts as a basis, and say that the rock can be taken out at 70 cts. per cu. yd., and the earth for 30 cts. per yd., we have an expenditure of some $3,500,000 for the excavation of this part of the canal alone. When in addition, the cost of right-of-way, land damages, road and railway crossings and the expense of excavating the lower level canal, and installing power and electrical machinery, buildings, etc., are considered, some idea can be obtained of stupendous piece of work which is being put under way. Apparently the total expenditure involved if this power development scheme is carried to completion as now planned will not fall short of $6,000,000.

In the work now nearly completed at Niagara Falls, the first aim of the company in charge was the development of the power, and its sale to users and the profits through sale of lands for manufacturing and residence purposes were secondary. In the enterprise of the Niagara Power & Development Co. the case is reversed. The plan is to found a great manufacturing city in the vicinity of Lewiston, and attract manufacturers there by the offer of free power; at least that was the scheme set forth by early prospectuses. We have called it a manufacturing city. Its projector calls it "Model City," and his plans for its development are set forth in a way that would make the most hardened old promoter of boom cities in the West and South turn green with envy. However, we have no intention to discuss at length the merits or demerits of this especial real estate scheme. What we do wish to do is to call attention to the question: Where is the limit to the profitable development of water-power?

It is a curious thing to notice how one craze after another runs its course in the popular mind, and infects not the unthinking masses merely but the intelligent men, financiers, business men, leaders of thought. Each new improvement of importance in the industrial world is at first looked on with suspicion and maligned until a few independent minds take it up; then, almost invariably the crowd rushes after and carries the idea to such extremes that in one way or another great mischief is done.

So it is with this matter of water-power development. Shrewd men have been quick to see that the great demand for power for electric lighting and electric railway purposes and the possibility of transmitting power over long distances electrically have made valuable many water powers which before were worthless by reason of their inaccessibility. The general public is now just coming to realize this, and many investors who are not shrewd enough to perceive the controlling limitations are likely to suffer loss.

Let us return to the development of power at Niagara. The tail race tunnel which is now completed is capable of carrying the water from turbines generating 125,000 HP. That is a greater amount of power than the combined total water-power used in the manufacturing cities of Lawrence, Lowell, Holyoke, Turner's Falls, Manchester, Bellows Falls, Lewiston, Cohoes, Oswego, Paterson, Augusta (Ga.), Minneapolis, Rochester and Lockport.

The question comes, What use is to be made of this enormous power, which will be "on tap" at Niagara in one or two months, and might, we believe, have been ready some time ago, had there been any strong demand for it? So far as we know, all the use of the tunnel for the present will be to discharge the waste water from the three 1,100-HP. turbines of the Niagara Paper Co. and three 5,000-HP. turbines driving dynamos in the power house of the Niagara Power Co. Here is a total of some 18,000 HP., all told, and the Power Co. is commendably prudent in hunting up a market for that amount of energy before it buys machinery to develop more.

A chief merit of the Niagara Falls enterprise from an investor's point of view lies in the fact that a large quantity of power may be profitably marketed at Buffalo, only 13 miles away. Buffalo is now the eleventh city of the United States in population, and it is largely a manufacturing city. Yet the total power used in that city for every purpose was determined by a careful canvass to be only 50,000 to 60,000 HP. Of course it will take a long time to induce all the manufacturers to give up their steam engines and substitute electric motors; and probably for some years the amount of current from Niagara sold in Buffalo for lighting and street railway purposes will exceed that furnished to motors in factories.

In a rough way, then, it may be said that the Niagara Power Co. will have water-power amounting to over 75,000 to 100,000 HP. still for sale, after it has supplied immediate wants at Buffalo and such establishments as have already begun to gather round it at Niagara Falls. What use can be made of this enormous power?

There are three directions toward which its owners are looking with some hope. The first is the field of electric locomotion on steam railways; the second is the greatly increased use of electricity for lighting; the third is electric propulsion on canals. That something may be hoped for in each of these directions, it would be idle to deny; but it must not be forgotten that each of these suggested uses for electricity is yet to be proved practicable on a large scale.

The electric locomotive has the inherent objection that it is dependent on a central station for its supply of power, and that any breakdown of the central station or of the line which conveys the current from it may entirely stop all traffic. With steam locomotives the breakdown of an engine only causes a slight delay, until another locomotive can be secured to take its place. To change to electric locomotion would be to put all the eggs in one basket. How long would it have been before trains could have been run during the recent strike in Chicago if the locomotives had depended on wires strung along the tracks for their supply of power? The enormous first cost of line equipment to convey the large amount of current required to haul heavy freight trains and fast expresses is also a serious difficulty in the way of the introduction of the electric locomotive. These are far from being the only difficulties. We only mention these to show that it is by no means certain that the substitution of electric for steam locomotives will follow, as a matter of course, even though electric current should be furnished as a free gift.

Turning to the increased use of current for lighting, we find that electric lamps have succeeded in displacing gas to a considerable extent; but the humble kerosene lamp is a much harder foe to drive from the field. With current furnished at nominal cost, the task will be easier; but, on the other hand, it must be remembered that the wiring for electric lights as now carried on is a work of such expense as to seriously hamper electricity's extension. The rapidly increasing use of Welsbach burners, too, by which the candle-power of a given amount of gas is quadrupled, is another thing which must be considered before we decide that electricity is destined to sweep gas entirely from the illuminating field.

The use of electricity to propel canal boats is a promising scheme, but as yet it is nothing more. Even granting that it should be found practicable, however, the total number of canal boats within a reasonable distance of Niagara would furnish a market for but a small part of the power which has been developed there.

A great deal has been said about the possibilities of disposing of power in other cities than Buffalo, and there has even been talk of transmitting it to New York and to Chicago; but it should be plainly understood first that the commercial feasibility of such schemes is yet to be proved even in theory. In considering the possibilities of any such long distance transmission, or even transmission over shorter distances, as to Erie, Dunkirk and other cities within a 50-mile radius, we must remember that the net cost of such power when delivered is limited by the price of steam power, and also by the cost at which power can be developed and transmitted from unused waterfalls at a less distance.

The facts are, then, that the Niagara Power Co. has at least 75,000 HP. of available power, for which at present no market exists, and which it must dispose of gradually, as the opening of new fields for the use of electricity and the increased demand for power create a market.

In view of these facts, the question, How long it will be before the 140,000 HP. which the Niagara Power & Development Co. proposes to make available can find a market? is a very interesting one. The prospectus referred to above disposes of this matter with the statement that it will be utilized to furnish free power to all manufacturers locating in Model City.

Is it not time that something emphatic was said concerning the popular delusion that cheap water-power is a sure magnet to attract manufacturers to a city? The customary argument is that because Manchester and Lowell and Lawrence and Holyoke and a dozen other cities were built up by the development of water-power a half century or more ago, therefore similar manufacturing cities will grow up about water powers developed at the present day. It is not alone in prospectuses and popular discussions that we find such statements. They even creep into the reports of engineers. Now when one stops to consider the facts of the case it is at once remembered that at the time when the great water-powers of New England were developed, steam power was only beginning to be an important factor in manufacturing. When the foundations were laid for the cities on the Merrimack, the steam engine was a machine costly to build and costly to operate, subject to rapid deterioration, and by no means as reliable as water-power.

At the present time all these conditions have been reversed. With steam and water-power at the same price per annum, steam would be preferred because of its greater reliability, greater steadiness, and especially because it can furnish heat and furnish steam for various industrial operations as well as furnish power. Further, the first cost of a steam plant to furnish a given power will generally be much less than the first cost of a water-power plant, and even though the yearly cost of operating the water-power plant be enough less to make the total yearly cost the same, yet the larger capital required will usually be counted against the water-power plants.

Again reductions in the total cost of power have made its relative cost, in comparison with other items in a manufacturer's expense account much smaller than formerly. The very language testifies to the esteem in which water-power was formerly held. "Mill privilege" in common New England parlance denoted any waterfall where power could be developed and used, whether it was improved or not. But nowadays proximity to markets or to raw material and good shipping facilities are matters of chief concern to the man about to build a factory. He scarcely bestows a thought to the matter of power until the important matter of site is decided. From this general statement we may except one or two special lines of manufacture, such as the reduction of aluminum from the ore and the manufacture of paper pulp. One concern in each of these lines has located at Niagara Falls. Two other lines of manufacture consuming large amounts of power are the textile industries and flouring mills. Niagara Falls is too far to one side of the district where textile manufacturers flourish to expect any great development of them there; but it would seem not unreasonable to expect that a large flouring mill industry may in time be brought to Niagara.

We are to consider the question, however, from the general point of view, as there is a large number

of places throughout the country besides Niagara Falls where water-power development on a large scale is already under way or is being actively discussed. From this general point of view, it would appear to be a risky venture in any locality to develop water-power very largely in excess of what can be disposed of to generate current for electric light and railway purposes, and to furnish power to existing concerns located within a reasonable distance. This is not saying by any means that in undertaking such an enterprise generous provision should not be made for future growth in the construction of permanent works, such provision, for example, as the Niagara Power Co. made in building its large tunnel. Nor is it to be forgotten that under such conditions as exist on the Pacific coast, or the Southwest, where high prices for coal and machinery make steam power expensive, development of cheap water-power may have an influence in attracting manufacturers which it does not have in the East.

Again it may often be possible for a water-power development company to gain enough income from the power for which it can at once find a ready sale to pay a fair income on the capital it has invested in its plant. Nothing can of course be said in such a case against its control of a large surplus of power and its erection of works ready for its utilization whenever the need for it shall arise. But in all such cases, let it be clearly understood that such funds as are invested to control and make possible the development of power which will not be marketed for a decade to come, are invested in speculation, and must run certain risks. It may be, on the one hand, that the schemes for long distance transmission and for the extension of electricity to a thousand fields where it is not now used may greatly increase the demand for power, enabling this speculative surplus to be disposed of at a good price. It may be, on the other hand, that the advance in other lines of engineering, in steam engines and boilers or in the gas engine may so cheapen the cost of power that the owners of water-power will find their profits much less than they now anticipate.

LETTERS TO THE EDITOR.

A VIRGINIA HIGHWAY BRIDGE.

Sir: I herewith send you, for the edification of your readers and as an addition to the literature on this subject, a detailed drawing of a "Combination Highway Bridge" erected last June over the Mattapony River at Dunkirk, Va., between King William and King and Queen counties. In this case, as in many others, I fear, the county road commissioners acted as engineers (?), and the bridge was built mainly from their designs, save some trivial revisions by the carpenters, etc. The river at this point is the head of navigation, except for occasional log-rafts and scows; to accommodate these the truss span, as shown in the drawings, was used.

It will be noticed that the river bank on one side of the stream is much lower than that on the other side. This, in the judgment of the engineers (!), necessitated the use of a 12% grade on the trestled portion of the structure. All material in the trestled portion is wholly of oak, while the truss is built of hewn pine of the dimensions shown. The piles are of unbarked white-oak, with an average depth of penetration of 6 ft. through mud and gravel into blue mud. The trestle bents consist of three piles each, the piles being surmounted by 12 × 12-in. caps, which are held in place by a 15-in. drift-bolt in each pile.

The two bents (or abutments) upon which the truss rests are on the same plan as those in the trestle, with the exception of having four piles each. Sheet zinc, as shown, was placed between the piles and caps, as a protection from the weather. When the elevation of high water, the rapidity of the stream, and amount and size of floating debris, drifts, etc., at times of high water is taken into consideration, we can fully appreciate the probable life of this structure.

This section of Virginia has yet to be introduced to her first iron highway bridge, although in many cases good substantial iron bridges could be erected for the same cost as one of these "combination structures." This structure is considered such a triumph of engineering skill by the commissioners and county officers, that two more of these "combinations" are contemplated in the near future, and this notwithstanding the fact that there are at present several bridges constructed nearly on the same order in the county, which were just left hanging from the effects of the last freshet.

Yours truly, Philip Aylett.

FORMULA FOR LENGTH OF COVER PLATES OF PLATE GIRDERS.

Sir: Having noticed, from time to time, in Engineering News, communications in regard to the determination of the lengths of cover plates for plate girders, I am led to offer a formula which gives the correct lengths for such plates, for uniform loads or for "equivalent uniform loads" over the girder. The formula is:

$$L = 2 \times \sqrt{\frac{(a\,h\,s - a_1\,h_1\,s) \times 2}{w}} + (2 \text{ ft. for rivets}).$$

In which:

L = Length of the cover plate required, in feet.
a = Flange area required at center of girder.
h = Effective depth of girder at center, in feet.
s = Unit of stress in flange.
a_1 = Area of flange at end of cover plate under consideration.
h_1 = Effective depth of girder at end of cover plate under consideration.
w = Uniform load or "equivalent uniform load."

It will be noticed that the term a h s is the maximum bending moment. To illustrate the use of the formula, assume a girder of 92 ft. effective length, and 96½ ins., out to out of flange angles. Let the maximum bending moment be 2,984,800 ft.-lbs. Then the maximum flange stress $= \frac{2{,}984{,}800}{8.05} = 370{,}800$, and the flange area required at 11,000 lbs. per sq. in. = 33.7 sq. ins. net.

Assume flange as follows:

2 angles 8 × 6 ins. × 73 lbs. = 14.6 − 2.2 = 12.4 sq. ins.
Effective depth for angles only = 7.8 ft.

I. 1 plate 20 × ⅝ in. = 12.5 − 1.25 = 11.25 + 12.4 = 23.65. Effective depth for angles and I. = 7.92 ft.

II. 1 plate 20 × 9-16-in. = 11.25 − 1.12 = 10.13 + 23.65 = 33.78. Effective depth for angles and covers = 8.05 ft.

Then for I. $L = 2 \times \sqrt{\left(\frac{2{,}984{,}800 - 12.4 \times 7.8 \times 11{,}000}{2{,}820}\right) \times 2}$ + 2 ft. = 76 ft.

and for II. $L = 2 \times \sqrt{\left(\frac{2{,}984{,}800 - 23.65 \times 7.92 \times 11{,}000}{2{,}820}\right) \times 2}$ + 2 ft. = 52 ft.

The following is the derivation of the above formula: The maximum bending moment at any point in a beam, whose distance from the center is x is given by the following well known formula: $M_1 = \frac{w\,l^2}{8} - \frac{w\,x^2}{2}$; too well known to be described, in which $\frac{w\,l^2}{8} = M$ = maximum bending moment.

$$\text{Then } M_1 = M - \frac{w\,x^2}{2},$$

M_1 and M being kept in equilibrium by the internal moments in the girder, may be replaced by them, and we have: $a_1\,h_1\,s = a\,h\,s - \frac{w\,x^2}{2}$; also $x = \frac{L}{2}$ whence,

$$L = 2 \times \sqrt{\left(\frac{a\,h\,s - a_1\,h_1\,s}{w}\right) \times 2} + (2 \text{ ft. for rivets}).$$

By the use of this or a similar formula, the error for the varying effective depth of the plate girder does not exist. Very truly yours, C. W. Hudson.

Phoenixville, Pa., Aug. 24, 1894.

NOTES AND QUERIES.

R. T. G., Lynchburg, Va., inquires the location of some railway (either steam or electric) which uses a grip track brake, one which actually grips the head of the rail, and not merely presses a sliding shoe against it. If any of our readers know of the use of such a brake, we trust they will inform us.

H. S. J. calls our attention to a slight error in the article on "Proportioning Wooden Beams and Posts" in our last issue. Equation (5) should have read:

$$\frac{d\,k}{b} = \frac{60{,}000}{m} \left(\frac{h}{l}\right)^3$$

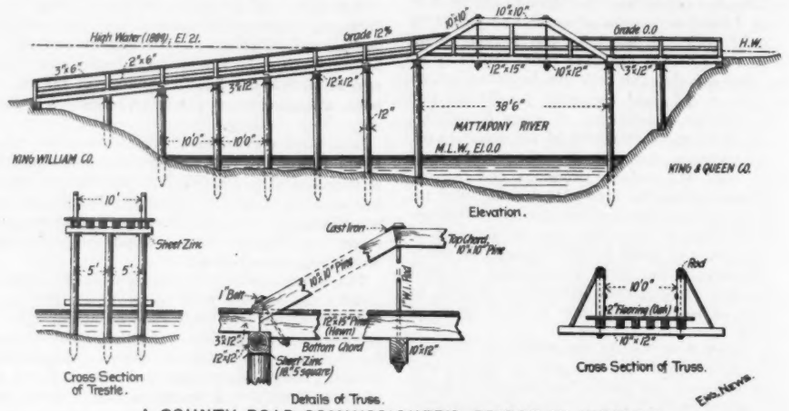
S. Taylor Wilson, of Phillipsburg, N. J., calls our attention to an omission in equation (4) in the discussion of "A Mathematical Investigation of Stand-Pipe Failures" in our issue of Aug. 16. The equation reads:

$$p_2 + p_1 = w^1\,x + \frac{2\,q\,x^2}{t\,d}$$

It should be:

$$p_2 + p_1 = w^1\,x + \frac{2\,q\,x^2}{t\,d\,\pi}$$

"Nemo" (who forgets to sign his correct name) refers to "Analytical Mechanics," by Prof. W. H. C. Bartlett, formerly of the U. S. Military Academy, as containing an excellent mathematical discussion of the problems relating to force and motion involved in Mr. Thos. H. Johnson's letter in our issue of Sept. 6. We believe, however, that the less calculus and algebra are used in such discussions, the better. While to the reader familiar with mathematics the solution may be clearer and briefer, only a small percentage of engineers can follow such a discussion with perfect ease; and it is better, therefore, so far as possible, to reason in a language that all can understand. As Prof. Mansfield Merriman said so aptly in his valuable paper on "Impact Tests" in our issue of Aug. 16: "Algebra usually beclouds the reasoning whose tool it is."



A COUNTY ROAD COMMISSIONER'S BRIDGE IN VIRGINIA.

BACTERIOLOGICAL STUDIES OF THE TORONTO WATER SUPPLY.*

By E. B. Shuttleworth.**

The water supply of Toronto is derived from Lake Ontario, through an intake located about 2,200 ft. from the shore of the island, which lies southward, in front of the city. The mouth of the intake is 18 ft. from the bottom of the water, which is there about 75 ft. deep. The supply passes, for a few hundred feet, through a 6-ft. steel pipe, and thence through a wooden pipe, to the south shore of the island, where it joins a steel pipe, and is carried a distance of some 6,000 ft. across the land. It here reaches Toronto Bay, which at this point is about 4,500 ft. wide, and is conveyed by a 3-ft. cast iron pipe, and a 4-ft. steel pipe, both of which terminate in a pumping well on the city side. The entire length of the conduit is nearly 2½ miles, the connections being made by cribs, fitted with manholes, through which samples of water can be obtained. These cribs mark the extension of the pipes lakeward, as the intake was at intervals of years carried further out.

The sewage of the city empties into the bay, which the two pipes cross, and the pumping well is, on one side, only separated from the bay water by a masonry wall, lined with cast iron plates. It will thus be seen that should there be any leak in either of these conduits, or in the connections with the pumping well, or in the well itself, the sewage-laden water would contaminate the supply. The sewage is distributed throughout the bay water, and, thus diluted, ultimately finds an exit by the eastern or western channels, which communicate with the lake at each end of the island, which is over three miles long, and extends in a somewhat crescent form in front of the city. The distance

* Paper read before the Montreal meeting of the American Public Health Association, Sept. 25, 1894.
** Professor of Bacteriology, Trinity Medical College, Toronto, and Bacteriologist to the Toronto Board of Health.

between the eastern and western channels to the intake is, in both cases, nearly the same, about 2½ miles.

I am, as yet, unable to present any statement as to the character of water taken from a point, say, in the middle of the lake, and at a considerable depth, where shore contamination would be reduced to a minimum. I have, however, obtained samples at a distance of over two miles from the island, or nearly five miles from the mainland. One of these was taken in October, 1893, where the water was 236 ft. deep, the sample being obtained at 180 ft. The other was taken in December, as nearly as possible in the same place. The average number of bacteria was 61 per cu. cm. Determinations, extending from April to September last, of water obtained from points not nearer the island shore than 2,200 ft., nor further than 4.040, that is, from 2½ to 3 miles from the mainland, and where the depths ranged from 75 to 182 ft., gave, for 56 determinations, an average of 191 bacteria per cu. cm. This will not represent the effect of exceptionally severe winter storms, when the disturbing action of the waves extends for nearly a mile from the island. I have purposely excluded a determination made on Jan. 19, 1894, when, in order to test the matter, I went out after a very heavy storm. An open boat, which, as the harbor was frozen up, could alone be used, did not offer sufficient protection from the high sea and bitter cold, so that I did not venture past the intake, but there obtained two samples which averaged 7,627 per cu. cm., and one 400 ft. nearer shore, which showed 9,335 per cu. cm. These figures have not been included in the general average, as I regard them as exceptional.

I think it may, therefore, be fairly assumed that within the shore distance specified, the normal number of bacteria, in this part of the lake, is about 100 per cu. cm.

Before the present intake was located I was engaged by the city engineer to determine the most favorable position and depth. The results of previous experience led me to formulate a general principle, that sewage or organic matter, and the organisms that live in it, must be regarded as sedimentary. Consequently, the best water would not be found at the bottom. On the other hand, molds, yeasts and air forms generally might be expected near the surface. The investigation of this point coincided with this. The average for six months, for 2 ft. from the bottom, at a depth of 73 ft., was 119, while 20 ft. from the surface there were 89 per cu. cm. The best position was found to be 20 ft. above the bottom, where the average was 66. A trial last August gave 235 for near the bottom, 190 near the surface and 120 at an intermediate point.

I have observed a like result in the examination of localities in Lake Simcoe, and in various ponds, and am led to the conclusion that, in water not violently disturbed, the least number of bacteria will be found between the top and bottom.

It has generally been found, by those whose opportunities for observation have been ample, that though it might be reasonably expected that the number of bacteria in water would be greatest in summer, the reverse is usually the case. An inspection of the frequent periodical examinations of Thames water, made by Frankland, in 1886-7-8, shows the lowest numbers to have been, respectively, in July, May and July, and the highest in December, November and January. In regard to the River Lea, another source of the London supply, the lowest months were September, April and May, and the highest December, January and April. The returns of Miquel, for Paris, in 1889, indicate the lowest and highest months for the Seine, Marne and Ourcq, to be, respectively, August and December, September and November, and June and December. Proskauer and Plagge's report for 1886, for Berlin, for the River Spree, gives September as the lowest and March as the highest. Fuller's statistics for 1891, of the examination of the Merrimac River water, at various points of the Lawrence, Mass., supply, show the highest and lowest months to be as follows: Intake, March and October; reservoir, June and December; city hall tap, May and December; tap at Experiment Station, May and December.

My weekly examinations of the Toronto water supply, as shown by samples taken from the tap of the laboratory of the board of health, during the past 18 months, exhibit a similar result, the lowest month being September and the highest February. The year may be divided into two bacteriological periods; the first, extending from May until September, inclusive, when the relative number of bacteria is small, and the second commencing with October, when the numbers suddenly increase greatly, and continue to do so until the middle of the winter, when they decline, and, about the end of April, as suddenly fall off.

Frankland, in alluding to the small number of bacteria in the Thames and Lea, during the summer months, says that it is mainly due to the fact that, during dry weather, these rivers are principally composed of spring water, while, at other seasons, they receive the washings of much cultivated land. This will not explain the case here, as the greatest numbers are found during the dead of winter, when the land is frozen, and very little water passes down the rivers. I feel confident that the large numbers in Lake Ontario water in winter are in some part due to stormy weather. Of this I had excellent opportunities of judging, when every violent storm on the lake was clearly reflected by the bacteriological examinations of tap water.

I am, however, inclined to think that bacteria are directly influenced by season. I am not enough of a botanist to say whether this is not, after all, only a matter of temperature, but I am convinced that in nature certain micro-organisms multiply most rapidly at certain seasons, and that cold water is for some of these much more favorable than that which is warm. In September last a yellow colony, probably that of bacillus ochraceous, made its appearance, very sparingly, on the weekly plates. When cold weather had set in, and the temperature of the water was reduced to that of its point of maximum density, the colonies of this organism were very numerous, composing the greater part of those which developed. This bacillus disappeared with the advent of summer, but, during the present month, September, I have again noticed several colonies. It is possible that this is a form growing only at considerable depth, where the temperature is always low, and that it is merely dislodged and carried nearer the surface by upward currents produced by storms. I do not, however, think that this is the true explanation, but, as I have before said, am inclined to the belief that bacteria, like other plants, have their own particular seasons of growth.

I venture to throw out the suggestion that this may have an important bearing in explaining the prevalence of typhoid fever at certain times during the year. This seasonal peculiarity is very well marked in Toronto, when every September shows a sudden increase in the typhoid rate, with a corresponding decline after October. Since last May I have been paying particular attention to the temperature of the tap water, which, up to the present, seems to be related to the development of this disease. I hope in future to be able to throw some light on this subject.

The experiments of Bolton, Wolffhugel and Riedel, Frankland and others, have indicated that it is possible for micro-organisms to exist and multiply enormously in distilled water, presumably free from, or at all events containing only the most minute traces of organic matter. These experiments have either been misunderstood or so twisted from their original intention as to militate against that science which they were designed to elucidate and support. It has been asserted that the presence of a large number of micro-organisms is no criterion of the quality of water, and that a mere enumeration of colonies is of little or no value. Without a thorough knowledge of all the accompanying conditions such evidence is certainly insufficient, though, speaking in a general way, I believe that it may be accepted that numerous bacteria indicate the existence of a sufficient quantity of food, which, in water, is commonly of the nature of sewage. "Wheresoever the carcass is, there will the eagles be gathered together;" or, to render the illustration more congruous, it may be said that a few weeds of a particularly hardy species may be found on poor soil, but, for number and variety, the ground must be rich.

It is for the comparative examination, at different times or localities, of a water of known character, and for the detection of sewage contamination, that a bacterial enumeration is most useful. Its sensitiveness exceeds that of the most delicate chemical test, and it admits of conclusions which are perfectly trustworthy. In order to prove this I may, perhaps, without being charged with vanity, be permitted to submit a few cases which have occurred in my own experience during the past two years.

For some time prior to 1892, the pumping well, which has already been described, was by some persons thought to be leaking, so that the diluted sewage from the bay found its way into the supply. In 1891 the death rate from typhoid stood at the extreme figure of 0.93 per 1,000, and the people were very properly excited. Chemical analyses, by several competent chemists, had frequently been made of the water of the intake and pumping well, but a fresh investigation was ordered and carried out without any satisfactory conclusion being arrived at as to the presence of sewage. I was asked to take part in this test, but, recognizing that I was no better qualified than others engaged in it, I decided to resort to a bacteriological method. The results seemed to me sufficiently conclusive to warrant a report to the city authorities that, not only was there evidence of the pumping well being leaky, but that, even at the shore of the island, the water was not identical with that of the intake, and some defect must consequently exist in the pipe that passed across the island and out into the lake.

I must confess that, at this time, the friends of bacteriology were exceedingly few and distrustful, so the report carried little weight and was quietly shelved. A subsequent accident to the 4-ft. pipe across the bay diverted what little civic and public attention had been excited, and it was not until several months after that the subject was revived. In May, the conduit from the island to the intake was examined by divers, when it was found that 300 ft. of the terminal lengths of the pipe had become disconnected, and were lying on the bottom, imbedded in sand. The supply had not, therefore, been derived from the intake, where the depth was 75 ft., but from a shoal, of 25 ft., that exists at this point. This was so far favorable to the bacteriological prediction.

It was next decided to test the pumping well, by emptying it completely, but this was found to be a matter of considerable difficulty, as numerous and large leaks existed, so much so that a steam pump had to be kept continually going in order to keep the well in such a condition that repairs could be carried out.

I have said that an accident occurred to the 4-ft. pipe across the bay. This necessitated extensive repairs, and when completed I was required to make a test of the work. The result showed both pipes to be leaky. Some breaks were discovered and made good, and another bacteriological examination followed, with a result similar to the first. This was no doubt far from pleasing to those who had conducted the work, and not at all reassuring to the public. It was decided that a mechanical test should be made by shutting off the pipes and taking the level of the pumping well. This critical test was made in the presence of many interested persons, who, for the most part, were very skeptical in regard to bacteriology. Both pipes were found to be leaking badly, and the vindication of modern methods was complete. I could, if need be, multiply instances of a similar character, but suffice it to say that the city engineer and his staff have taken every advantage of the assistance of the health department in all matters pertaining to the integrity of the conduit, and thereby many defects have been discovered and remedied. It has been shown to be possible for the bacteriologist to keep his finger on the pulse of the conduit, so that the slightest deviations can be detected, and the public now seem to be perfectly satisfied that such is the case.

I cannot allow this opportunity to pass without a brief reference to the relation of bacteria to typhoid fever, which, with regard to Toronto, has already been alluded to in the last annual report of the Health Officer, Dr. C. Sheard. The statistics from December to October, 1893, were therein plotted, the abscissas being monthly periods of time throughout the year, and the ordinates the numbers of bacteria per cubic centimeter and the numbers of typhoid cases. A comparison of the latter showed a wonderful parallelism, which might or might not have been accidental. During 1890 and 1891, in which the conduit and pumping well were admitting sewage-laden water, the annual typhoid rate was the same, 0.93 per 1,000, but between July, 1893, and July, 1894, when the more serious defects had been repaired, the proportion diminished to 0.16 per 1,000. The accident which befell the pipe across the bay, on Dec. 25, 1892, by which large quantities of sewage gained access to the supply, increased the number of bacteria, as shown by a service pipe in the upper part of the city, from 25 to 1,040 per cu. cm., and the monthly typhoid cases from 35 to 112, increasing next month to 139. Judging from previous years the number of cases should have fallen at this period. The sudden rise was quite exceptional, and affords additional and very conclusive evidence of the close relation which exists between sewage contamination and typhoid fever.

MILEAGE OF STREET PAVEMENTS IN THE UNITED STATES.

The following note on the status of city pavements in the United States was prepared by Mr. J. W. Howard, C. E., of New York, in response to numerous inquiries. It was compiled by him from official data. Eighty cities of the United States, containing each more than 25,000 inhabitants, and a total of 10,370,721 inhabitants, on Jan. 1, 1892, had streets and pavements as follows:

	Miles.	Per cent.
Total paved streets	6,484	39
" unpaved streets	10,222	61
Total opened streets	16,706	100

Kinds of pavements.	Total laid during 1891. Miles.	Per cent.	Total laid and in use, Jan. 1, 1892. Miles.	Per cent.
Asphalt	79.6	15½	377.0	6
Granite	64.3	12½	721.5	11
Other stone	34.	6½	[4]1,560.8	24
Brick	54.5	11	175.5	2
Asphalt block	2.1	1	45.1	1
Wood	[1]110.9	21½	[2]832.3	13
Macadam and Telford.	163.6	32	[3]2,715.9	42
Coal tar and misc.	.5	..	[5]55.8	1
Totals	509.5	100	6,483.9	100

[1] Chicago, 75 miles; [2] Chicago, 482 miles of this wood; [3] Washington still has 38 miles of this coal tar; [4] Principally cobblestone; [5] Very little telford, mostly macadam. Note.—Baltimore, San Francisco and Omaha are not included because of incomplete returns at that date.

A supplementary table, bringing the figures down to the present date, will appear within a few weeks.

WEATHER TABLE FOR AUGUST, 1894. (Furnished to Engineering News by the Department of Agriculture.)

	Stations.	Temperature. (Deg. Fahr.) Average.	Max.	Min.	Range.	Wind. Velocity in miles per hour. Average.	Max.	Direction at time of max. velocity.	Precipitation—rain or melted snow—inches. Total.	Heaviest in 24 hours.	No. of rainy days.
Northern Cities.	Northfield, Vt.	61.2	84	35	51	7.1	30	W	3.23	2.11	11
	Portland, Me.	64.6	88	46	42	6.0	21	NW	3.27	2.26	9
	New York, N. Y.	72.8	90	55	35	8.9	26	NW	1.54	.77	7
	Pittsburg, Pa.	73.6	93	51	42	4.6	20	SW	.43	.37	5
	Chicago, Ill.	70.8	95	48	47	14.2	43	SE	.60	.25	5
	Omaha, Neb.	77.8	99	53	46	6.4	36	NW	.36	.25	4
	St. Paul, Minn.	72.2	96	48	48	5.6	26	NW	.36	.24	5
	Duluth, Minn.	64.9	90	50	40	5.7	23	NE	1.08	.51	5
	Bismarck, N. Dak.	71.7	100	43	57	8..	36	NE	.42	.13	8
	Average	70.0	93	47	45	7.3	29		1.25	.77	7.6
Southern Cities	Washington, D. C.	74.0	92	54	38	4.3	26	SW	2.00	.86	8
	Louisville, Ky.	78.6	99	54	45	6.3	32	NW	3.57	1.36	7
	St. Louis, Mo.	78.6	100	60	40	8.0	36	SW	1.66	1.02	6
	Savannah, Ga.	81.2	99	67	32	6.1	38	N	7.28	2.26	21
	Kansas City, Mo.	78.3	100	55	45	6.1	24	NE	.13	.13	1
	Jacksonville, Fla.	82.2	96	68	28	6.5	30	SE	9.24	1.92	19
	Chattanooga, Tenn.	77.6	98	63	35	5.1	38	NW	2.96	1.31	13
	New Orleans, La.	80.5	92	71	21	5.5	30	NE	7.32	2.58	15
	Memphis, Tenn.	78.7	97	60	37	5.2	36	SE	5.11	2.01	13
	Palestine, Tex.	79.4	96	58	38	4.4	26	NW	5.45	1.82	13
	Average	78.9	97	61	40	5.7	32		4.47	1.53	12
Western Cities.	Helena, Mont.	70.4	95	48	47	6.8	36	SW	.40	.14	7
	Port Angeles, Wash.	59.8	81	45	36	4.9	24	W	.36	.29	3
	San Francisco, Cal.	59.2	91	49	42	13.9	38	SW	.....	.....	0
	Salt Lake City, Utah	75.4	93	56	39	5.9	30	W	.87	.35	6
	Santa Fe, N. Mex.	64.5	83	49	34	5.4	28	E	1.95	.63	16
	Denver, Colo.	71.2	94	49	45	6.3	30	NE	1.86	1.21	12
	Yuma, Ariz.	89.9	110	66	44	6.7	29	W	.10	.09	2
	Average	70.0	93	52	41	7.1	31		.79	.39	7

The Algerian phosphate beds, says the American Consul at Algiers, will yield from 30,000 to 35,000 tons during 1894, against 5,000 tons in 1893. This phosphate is delivered in Italy at $5.75, and in England at $6.50 per ton; and as the industry is barely developed, the Consul believes that it is destined to seriously compete with the American deposits. The supply is apparently inexhaustible, and under the improved methods introduced for handling it, its production is cheap. The owners even expect, within a few years, to ship it to America with profit.

A 40-mile canal for the development of water-power from the Platte River is proposed at Omaha; and Douglas county, in which Omaha is situated, is to vote next month on the proposition to issue $1,000,000 in bonds in aid of the enterprise. It is provided that the city may purchase the canal at any time prior to Aug. 1, 1896, or at a date 20 years from that time. The bonded debt of the company must not exceed $2,000,000, and it must furnish free power to the county for 99 years. The annual rates of rental for power in Omaha and South Omaha for 308 days of 10 hours each are fixed on a sliding scale, and vary from $55 per HP. for less than 5 HP., to $23 per HP. for 500 HP. or over. The canal is to be completed by Oct. 1, 1898, and the company is to receive the bonds from time to time as section after section of the work is completed.

Water filters for the public schools of Milwaukee are under consideration by the Council Committee on Health and Public Schools. There are 48 schools in the city. Filter manufacturers are now invited to submit filters for trial.

The city of Tacoma, Wash., has brought suit against the Tacoma Light & Water Co. for $1,000,000 damages for false and fraudulent representations which led the city on July 1, 1893, to buy the water and light plants of the company for $1,750,000, paid in city bonds. The city claims that the water supply which can be obtained from certain springs bought from the company is only 2,500,000 gallons daily, whereas the company represented it as 10,000,000 gallons. The city in bringing suit claims that the water plant is worth only $572,936 and the light plant $177,604, making a total of $750,540. At the time of the sale there was violent agitation against it and a popular vote gave less than 100 majority for the purchase.

The total of killed and injured from all causes in the working of the railways of Great Britain and Ireland for the year 1893, is given as follows in the General Report of the Board of Trade:

Passengers:	Killed.	Injured.
From accidents to trains, rolling stock, permanent way, etc.	17	484
From other causes, including want of caution or misconduct	89	737
Servants of company, or contractors:		
Accidents to trains, etc.	10	73
From other causes, as above	450	2,558
Other persons:		
Passing at level crossings	55	30
Trespassers	274	135
Suicides	86	...
Miscellaneous, not included in above	30	92
Total	1,011	4,109

The total mileage considered is 20,646 miles. The total of passenger-journeys, exclusive of journeys by season-ticket holders, was 873,177,052 for the year 1893. Thus one passenger in 8,237,519 was killed and one in 715,132 was injured. In 1892 one passenger in 6,701,049 was killed and one in 641,272 was injured.

The resistance of aluminum to corrosion when immersed in water is of importance in a number of its industrial uses. The Physical Institute of Berlin has been making a number of experiments to test this, and a brief resume of results is given in Dingler's "Polytechniches Journal," as follows: An aluminum tube, giving an analysis of 0.58% silicum; 0.32% iron, and no trace of lead or copper, was submitted to the water corrosion test. With this was an aluminum plate, with 0.72% silicum, 0.50% of iron and 0.25% of copper. The experiments showed that after 120 hours' immersion in water of a variable composition the aluminum was corroded; and the corrosion was greater in slightly warm water, coming from the city pipes, and least when plunged into cold, distilled water. The corrosion penetrated equally towards the interior of the metal. Brass is said to have behaved much better than the aluminum under these circumstances. Dingler remarks that while these aluminum samples cannot be regarded as pure, in the absolute sense of that term, they yet approach near to the average aluminum metal used in the arts and called pure.

"The Hydro-Geology of the Upper Mississippi Valley and Some of the Adjoining Territory" is the title of an exhaustive and interesting paper by Mr. Daniel W. Mead, read before the Western Society of Engineers, and published in the July number of the "Journal of the Association of Engineering Societies." The paper occupies some 65 pages of the Journal and is accompanied by several inset sheets, mostly in colors, showing the geological formation of the country in question. The paper contains numerous figures regarding geology, natural drainage, city water supplies and artesian wells, including chemical analyses of the water of the region, which will doubtless be highly valued by hydraulic engineers having to do with that section. Mr. John C. Trautwine, Jr., is now secretary of the Association of Engineering Societies, and editor of its journal, with headquarters at 419 Locust St., Philadelphia.

A new system of smoke prevention for locomotives is said to be in use on 35 locomotives of the Northwest Ry. of Prussia, the apparatus being the invention of Mr. Theodore Langer, a mechanical engineer in the service of that railway. The usual extravagant claims are made of perfect combustion, freedom from smoke and great economy of fuel. The descriptions of the invention which reach us through the German technical papers are so vague that little can be made out of them; but apparently the invention consists chiefly in an apparatus for admitting air above the fire after each supply of fuel is thrown in. The opening for the admission of air is then slowly closed by an automatic device, as the new coal becomes coked. A steam jet is also used for mixing the air and gas in the combustion space.

The railway mileage of the United Kingdom, on Jan. 1, 1894, aggregated 20,646 miles open for traffic, or 9,374 miles of single and 11,272 miles of double track. The Blue Book of the Commercial and Statistical Department of the Board of Trade, from which these figures are taken, commenced its records in 1854 with only 8,053 miles of railway open. On Jan. 1, 1894, the total authorized capital was $5,454,493,900, of which $4,856,616,705 has been issued and presumably spent. On the latter figures the average spent per mile of railway is $235,235. In 1893 these railways carried 873,177,052 passengers, exclusive of season-ticket holders, and this passenger traffic brought in a gross revenue of $169,247,245, or 44.46% of the total receipts. They carried 207,836,308 tons of minerals and 85,454,493 tons of general merchandise a total distance of 141,781,020 miles, which yielded a gross revenue of $204,973,185, or 50.84% of the total receipts. The gross operating expenses were $208,475,595, or 57% of the total receipts. The net revenue of $174,683,865 represents 3.60% on the invested capital. This average rate of interest was always above 4% until 1886, but since that time there has been a steady decrease and that of 1893 is the lowest on record. The ratio of operating expenses to earnings in 1893 was also the highest on record; the smallest being 47% in 1860, 1864 and 1871. Since the latter year it has always been above 50%. In 1893 the approximate numbers of first, second and third-class passengers carried was 30,000,000, 60,000,000 and 782,000,000 respectively.

A suspension bridge of 110 ft. span, c. to c. of towers, has recently been built to carry a government road over the Doyang River in Assam, India, and is peculiar in having latticed steel towers resting on pin bearings on the abutments. The two towers at each end are braced together at the top, and the cables are fastened to the towers, the latter thus forming the saddles in themselves. The two cables are each composed of two lines of forged eyebars, 10 ft. c. to c. of pin holes, with the suspension rods hung from the pins and carrying two latticed girders whose ends rest on the masonry abutments. The roadway, carried by the lower chords of the girders, is 6 ft. 6 ins. wide in the clear. Each pair of suspension rods carries two channel floor beams, 10 ft. apart, and between these are two T-bar beams 3 ft. 4 ins. apart. Upon these is a floor of corrugated steel plates covered with a paving of broken brick. The roadway is 12 ft. 6 ins. above flood level and 28 ft. above low water. A number of these bridges are being erected, and the material has had to be carried great distances over bad roads in the hill country. The shore ends of the cables are anchored in the rock, the anchorages being reinforced by boulders heaped over them. The roads in some cases approach the bridge almost at right angles on each side. The structures were built by Westwood & Baillie, of London, England, and are being erected under the superintendence of Mr. D. J. Clancey, Executive Engineer.

It is proposed to harden aluminum and its alloys by the addition of boron, says the "Moniteur Industriel," which journal ascribes the invention to a Mr. Warren, of Liverpool. According to this journal, the alloy of aluminum and boron is prepared by introducing the metal into a furnace with a mixture of fluorspar and vitrous, anhydrous boric acid. This is then treated by the oxyhydrogen blowpipe. The boric acid is reduced, and the boron resulting dissolves in the aluminum, to which from 5 to 10% of copper is added.

To measure deformation of the crest during the filling of the Vyrnwy dam, and also the movements due to changes in temperature, the engineer, Mr. G. F. Deacon, had a 4½-in. hole bored through the masonry about the middle of the dam and extending 80 ft. below the crest into a tunnel running into the dam. This hole was made during construction by drilling before the stones were laid. A fine steel wire was passed through this hole, with a heavy weight attached, and a seismograph was connected with the bottom of the wire, making a continuous record on plate glass with the motions magnified four times. At a late meeting of the Institution of Civil Engineers, Mr. Deacon said that during the filling of the dam, from the 13-ft. level to the top, the deflection of the sill, with relation to a point 80 ft. below, was .034 in. The height of the dam from the lowest point of the foundation to the crest is about 150 ft. The difference between night and day temperature causes a measurable daily movement; but the maximum motion yet recorded, due to temperature changes, is .0144 in.

The subject of railway communication between India and Burmah is again occupying the attention of the government of India, and a reconnaissance party will, during the coming cold season, examine the country between the terminus of the Assam-Behar Railway (meter gage) at Jatrapur, and the Burmah State Railway, with a view to a connection. The project will involve the bridging of the Brahmapootra River.

A powerful express locomotive exhibited at the Antwerp exhibition by the Belgian State Railways has four driving wheels and a single leading and trailing axle, the leading axle being carried in radial boxes. The general arrangement is similar to that of the engine illustrated in our issue of July 18, 1891, but the spring over the main driving axle is now supplemented by an uncambered spring placed below the axle and connected to the equalizing lever. Engines of

somewhat similar arrangement have been built by the Baldwin Locomotive Works for express service on the Philadelphia & Reading R. R. (Eng. News, June 15, 1893), but these engines have the leading wheels as a pony truck, and the main driving axle is the rear instead of the forward coupled axle. The Belgian engine has inside cylinders 19.7 × 23.6 ins.; driving wheels 6.89 ft. diameter on 7.06 ft. wheel base, and carrying about 30 tons weight out of a total of 50 tons. The leading and trailing wheels are 4 ft. in diameter.

Tests of malleable iron to determine the depth to which the decarbonizing extends were recently made at the laboratory of the Riehle Bros. Testing Machine Co., in Philadelphia. A variety of test specimens from different foundries was used, varying from ⅝ in. diameter to 1¼ in. diameter; and while the smaller diameters approached wrought iron in strength and ductility, the larger specimens were not materially different from cast iron. The skin was turned off from several test pieces and they were then broken with similar results.

The administration of the U. S. Naval Observatory at Washington has been reorganized by an official order issued by Secretary of the Navy Herbert. It was objected that under the former system all scientific men were required to report in all things to a line officer of the navy, who was at the head of the bureau, but was not in sympathy with the scientists or their work. The Secretary of the Navy by this order appoints Prof. Wm. Harkness as astronomical director, in full charge of and responsible for the direction, scope, character and quantity of all purely astronomical work at the Observatory. He has complete control over all his subordinates, and reports directly to the Secretary. The old regulations provided for an assistant to the superintendent in charge, an astronomical director, a head of the department of nautical instruments, a head of the department of chronometers and time service, and a head of the department of magnetism and meteorology. As we interpret the order, it applies only to the astronomical portion of the work, the rest remaining as at present, under the control of a line officer of the navy.

Leaves of gold, approximately four-millionths of an inch thick, were exhibited by J. W. Swan, F. R. S., at the June meeting of the Royal Society in London. The films were prepared by an electro-deposit of gold upon a highly polished and extremely thin electro-copper deposit. The copper was finally dissolved by perchloride of iron and the gold film taken up on glass. The gold film was transparent and continuous. The "Franklin Institute Journal" reminds Mr. Swan that the same thing was done by Mr. A. E. Outerbridge, Jr., and explained in a lecture before the Institute delivered May 7, 1877. Mr. Outerbridge, in his first trials, deposited the gold on a burnished strip of copper 1-1,000 in. thick, and found that one grain of gold would perfectly cover 200 sq. ins. of the copper. The thickness of this gold film was 1-980,400 in. In later trials he removed the gold film by eating away the copper by immersion in weak nitric acid, and finally produced films only 1-2,798,000 in. thick. In the latter case one grain of gold would cover nearly 4 sq. ft. of copper with a continuous plating, showing a fine gold color.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago—Existing Roads.

BALTIMORE & OHIO.—The contract for laying the track on the extension, from Wooster, O., south to Millersburg, 19 miles, has been awarded to M. J. Deyton, who will begin work at once. The extension was graded last year and is to be completed this fall. Connection will be made at Millersburg with the Cleveland, Akron & Columbus.

CHARLEVOIX & FREDERIC.—It is stated that between 12 and 14 miles of this railway has been completed northwest from Frederic, Mich., and that the grading is nearly finished to Charlevoix. About 65 men are now at work on the line. The road is being built by David Ward, and will be used chiefly for logging purposes.

Projects and Surveys.

BLUE MOUNTAIN.—The Baltimore "Sun" states that William C. Mayne, solicitor of the Blue Mountain R. R., noted in our issue of Aug. 9, authorizes the statement that work on the line between Harrisburg and Slatington will be pushed forward at once, and that at a recent conference in New York, which was attended by Chauncey M. Depew, arrangements were made to connect the line with the Vanderbilt system by way of the Poughkeepsie bridge. Also that the West Virginia Central R. R. Co. is aiming to extend its lines to the Susquehanna River to connect with the Blue Mountain road.

CAPE ANN GRANITE.—Incorporated in Massachusetts to build a railway two miles in length between Gloucester and Rockport, Mass.; capital stock, $20,000; incorporators, J. H. French, Scott Webber, Gloucester, Mass.; Geo. E. Craig, Walpole; W. H. Pearson, Boston; C. H. Cleaves, Rockport.

COLUMBUS, HOCKING VALLEY & ATHENS.—It is stated that four corps of engineers are at work on this projected railway, from Columbus to Athens, O., a distance of about 70 miles. The company was granted authority by the last state legislature to use the Hocking Canal for a roadbed. A correspondent writes us that the road is projected as a coal road, but that there are already five railways in the Hocking coal region, and that these companies control almost all of the available land.

ENGLISH CENTER & ROARING BRANCH.—Daniel Kavanaugh and Robt. J. C. Walker, Williamsport, Pa., are interested in a proposed railway between English Center and Roaring Branch, on the Northern Central, a distance of about 20 miles. The route has already been surveyed, and it is expected that the grading will be commenced this fall.

KEYSTONE & NORTHERN.—The New Castle, Pa., "News" states that a new railway, to be known as the Keystone & Northern, is about to be constructed from Ellwood City, through Wayne and Slipperyrock townships, to Rose Point. The route has been surveyed several times. The new road will connect with the Pittsburg & Western at Ellwood City and run to Rose Point, where it will make a circle and come to this city, over the old Negley roadbed, surveyed several years ago. It will open up extensive limestone quarries, coal mines and ore mines, in the vicinity of Rose Point, Pa. The road is to be completed Jan. 1, 1896.

LOYALHANNA & YOUGHIOGHENY.—Press reports from Greensburg, Pa., state that the construction of this railway will soon be commenced. The report continues: The line will be operated in connection with the Philadelphia & Pittsburg, surveyed and located through Indiana county, Pa. Both lines practically constitute the Beech Creek extension from Mahaffey, Clearfield county, to Sewickley, on the Pittsburg, McKeesport & Youghiogheny, and will use the Pittsburg & Lake Erie terminals at Pittsburg. The financial head of the undertaking is John Pitcairn, of Philadelphia. He is assisted by a number of Pittsburg people prominent in railway circles. One of the large carrying companies in which the Vanderbilts are interested is a financial factor, and will afford tidewater and New York terminals. A great deal of careful and methodical work has been done in the way of permanent location. Connection will be made with the Buffalo, Rochester & Pittsburg, at Punxsutawney and with the Pittsburg, Shenango & Lake Erie, at Butler, Pa. The road will make an outlet from the Connellsville region to the seaboard, the lakes, Canada and the West. The seaboard route will be 25 miles shorter than that of the Pennsylvania road. The road will enter this county at the mouth of the Loyalhanna Creek, follow the creek to the mouth of Ninemile Run, near Latrobe, crossing Summit at Lippus, and down the Sewickley to its mouth.

PROVIDENCE, PONAGANSETT & SPRINGFIELD.—This company has petitioned the city of Providence, R. I., to guarantee the interest on $1,000,000 of 30-year 4% bonds to aid in the construction of its proposed line to Springfield, Mass.

Southern—Existing Roads.

CHATTANOOGA SOUTHERN.—Press reports state that a contract has been awarded for building a four-mile extension to Round Mountain, Ala., where the Rome Iron Co. is operating a furnace. The extension will be completed as soon as possible.

ROARING CREEK & CHARLESTON.—The Pittsburg "Chronicle Telegraph" states that this railway has been completed and opened from its junction with the West Virginia Central & Pittsburg, 35 miles down to Cassidy Park headwaters. The road is built through coal and timber country, and already four new mines and five saw mills are in operation along the line.

Projects and Surveys.

HINTON & NEW RIVER.—Contracts are about to be awarded for building this projected railway, according to reports. The road will be about 33 miles in length. Pres., J. H. Miller, Hinton, W. Va.

Northwest—Existing Roads.

CHICAGO GREAT WESTERN.—It is reported that this company will double-track a good part of its line in Illinois.

Projects and Surveys.

RUSHVILLE & ROCKPORT.—A press report states that St. Louis capitalists propose to build a railway from Rushville to Rockport, Pike county, Ill. The road will be about 60 miles in length, passing through Schuyler, Brown and Pike counties. The cost is estimated at $700,000. The capitalists ask the right of way and $50,000. Both Rushville and Rockport, Ill., are on the Chicago, Burlington & Quincy, and this proposed road would form a connecting line between two divisions of that road.

Southwest—Existing Roads.

GULF & INTERSTATE.—L. P. Featherstone, Secy., Galveston, Tex., states that the grading and bridging on this railway, as noted Sept. 20, are progressing as rapidly as the rainy weather will allow.

HOT SPRINGS.—It is reported in Arkansas that this short railway, from Hot Springs to Malvern, has been purchased by the Illinois Central, and will be extended from Malvern to Helena or Arkansas City, passing through Pine Bluff and Sheridan.

LITTLE ROCK & MEMPHIS.—J. W. Rose, Secy., Little Rock Bridge & Terminal Co., is reported to have received a telegram from J. H. Smith, secretary of this company, stating that the owners will be ready to render substantial assistance as soon as the levying court shall have extended the time for completing the bridge and terminals. The railway company has also in contemplation the construction of a line which will be virtually an extension of the present road from Little Rock to Wister Junction, Ind. T., to connect with the St. Louis & San Francisco, and thus secure a valuable Texas connection as well as an important connection with the Choctaw Coal & Ry., now reorganized on a strong financial basis.

MISSOURI, KANSAS & TEXAS.—The directors of this company have incorporated the Southwestern Mineral Ry. Co., with a capital stock of $600,000, to build an extension from Joplin, Mo., to Parsons, Kan.

PECOS VALLEY.—About 53 miles of the extension north from Eddy, N. Mex., have been completed and opened to traffic, and it is expected that the entire extension to Roswell, N. Mex., will be completed next week. The extension is 74 miles in length. Pres., J. J. Hagerman, Colorado Springs, Colo.

SAN ANTONIO & GULF SHORE.—It is stated that 40 miles of the grade of this railway in Texas has been completed, and tracklaying will be commenced about Oct. 15. The bridge timbers for several bridges on the line and two new engines have arrived at San Antonio. The telegraph line will be built this week.

TEXARKANA & FORT SMITH.—Press reports state that contracts have been awarded for the completion of this railway from Fort Smith, Ark., to Shreveport, La., within three years. Some 36 miles north from Texarkana have been completed, and 40 miles additional have been under contract for some time. The line is being built north to connect with the Kansas City, Pittsburg & Gulf, which is already in operation south to Siloam Springs, Ark., and is being rapidly extended. A. E. Stilwell, Kansas City, Mo., is vice-president of both companies.——The Kansas City, Shreveport & Gulf R. R. Co. was incorporated Sept. 27 with a capital stock of $1,000,000, to build a railway from Shreveport, La., to Sabine Pass, Tex., on the Gulf of Mexico. The incorporators are chiefly officials of the T. & F. S. and the K. C., P. & G. companies; Pres., W. S. Taylor (Pres., Texarkana & Fort Smith, and Secy. and Treas., Kansas City, Pittsburg & Gulf); Secy. and Treas., F. B. Hubbell (Secy. and Treas., Texarkana & Fort Smith).

Rocky Mt. and Pacific—Existing Roads.

ARIZONA & SOUTHWESTERN.—An extension of this railway was completed last week to Benson, Ariz., on the Southern Pacific. The extension parallels the Santa Fe a distance of about 18 miles.

BUTTE, ANACONDA & PACIFIC.—It is stated that 75 grading teams and scrapers from the Burlington & Missouri River extension to Billings have arrived at Anaconda to commence the construction of the proposed extension of this railway, and Marcus Daly, Pres., Anaconda, Mont., is reported as stating that fully 1,000 men will be at work on the line west of that city within two weeks. The line will be located south to Missoula at once.

COOS BAY, ROSEBURG & EASTERN.—The construction has been commenced on an extension from Myrtle Point east toward Roseburg, Ore., 63 miles, and it is stated that 1,000 men and a large number of teams will soon be at work on the line. Ch. Engr., S. Z. Earle, Marshfield, Ore.

SAN PETE VALLEY.—The grading has been completed on the eight-mile extension of this railway to Morrison, a new coal camp, and tracklaying will be commenced within a few days. This extension makes the mileage of the road 52 miles, extending from Nephi through the San Pete valley to the present terminus. It is stated that Theodore Bruback, Pres., has gone to England, where he expects to obtain enough capital to make a further extension of the line south to Nevada. The present survey extends for 353 miles from Salt Lake City to the Southeastern Nevada line. A part of the right of way over Government land has been approved by the secretary of the interior, and a further approval of the entire survey is expected at any time. The road now parallels the Rio Grande Western for a distance of 15 miles and is a feeder for the Union Pacific system.

SANTA FE, PRESCOTT & PHOENIX.—The construction has been commenced on the extension south from Phoenix, Ariz. The line is in operation from construction between Prescott and Phoenix, 136 miles, construction between Prescott and Phenix, 136 miles, about 1,500 men being now at work at Congress, 80 miles north of Phoenix. From Phoenix the line will be built to Florence, Tucson, Calabesas and Nogales, where a connection will be made with the Senora line of the Santa Fe system. Vice-Pres. and Gen. Man., G. W. Vaughn, Prescott, Ariz.

Projects and Surveys.

SAN FRANCISCO, STOCKTON & SAN JOAQUIN.—This company is being organized by the Traffic Association of San Francisco to build a railway from San Francisco, through Fresno to Bakersfield. The capital stock will probably be $6,000,000, and it is claimed that the road will be built at an early date. Isaac Upham, F. W. Van Syckle, B. F. Dunham, Thos. Magee and Alvina Hayward, all of San Francisco, have been selected as trustees of the railway company to vote the stock and operate the road strictly as a competing line. Each trustee is pledged to prevent the road being absorbed by a competitor, and it is expected that the local freight rates will be reduced 40% by this management and competition.

UTAH & WYOMING.—The Salt Lake City "Tribune" states that the directors of this company have decided to construct the line to Coalville at an early date. The maximum grade will be 2.8%, and the work will include a tunnel. Pres., B. F. Raybould; Vice-Pres., W. L. Pickard; Secy. and Treas., S. F. Walker; Ch. Engr., Edmund Wilkes; principal office, Salt Lake City, Utah.

Foreign.

MEXICAN INTERNATIONAL.—The final survey for the extension of this railway from Reata to the city of Monterey has been completed and the right of way appraised. From Monterey the road will be extended to the San Pedro mining district. The depot grounds at Monterey have been purchased.

STREET AND ELECTRIC RAILWAYS.

BRIDGEPORT, CONN.—It is reported that arrangements are being made to extend the Bridgeport Traction Co.'s electric railway to Shelton, a distance of seven miles.

SYRACUSE, N. Y.—A new company is being organized to construct an electric railway in this city. D. H. Murray, F. M. Boats and J. P. Dunlap are interested.

EAST STROUDSBURG, PA.—The council has granted a franchise to the Delaware Valley Electric Ry. Co.

PHILADELPHIA, PA.—The Philadelphia, Bala & Narberth Ry. Co. has been incorporated to construct an electric railway; capital stock, $24,000; Pres., J. A. Logan, Bala.; directors, D. E. Williams, A. L. Fritz and G. M. Dorrance.

NANTICOOKE, PA.—A company has been incorporated to construct an electric railway from this place to Wanamie and Glen Lyon, a distance of 10 miles; capital stock, $60,000; Pres., K. M. Smith, Newport; directors, G. T. Morgan, B. A. Bache, Nanticoke.

CHARLESTON, W. VA.— The Great Kanawha Falls Water Power Electrical Mfg. & Land Co. has been chartered with a capital stock of $2,000,000. It is proposed to construct an electric plant at the Great Kanawha Falls to generate electricity for mines, factories, railways and for lighting purposes. The principal stockholders are Charles M. Reed, of Baltimore; A. McClintock, of Philadelphia, and A. O. Patton, W. W. Tompkins, W. F. Scott, T. F. Snyder and M. Levi, of this city.

CATLETTSBURG, KY.—The council has granted a franchise to the Ashland & Catlettsburg Electric St. R. R. Co. It is proposed to extend the line to Hampton City.

COVINGTON, KY.—The South Covington & Cincinnati St. Ry. Co. has completed its line to Ludlow and Bromley, and is reported as considering extending the line to Highland Cemetery, at an estimated cost of $70,000. The property owners on the proposed route have offered a bonus of $30,000.

BELLAIRE, O.—It is reported that the Bellaire, Bridgeport & Martin's Ferry Electric Ry. Co. proposes to extend its line to Shady Side, a distance of two miles.

CHILLICOTHE, O.—The Chillicothe Electric R. R., Light & Power Co. has been incorporated with a capital stock of $100,000; directors, J. P. Myers, J. A. Poland, W. A. Story, R. Enderlin and J. M. Klingelsmith.

MARION, O.—The Marion Electric Power & Road Co. has been granted a franchise for a railway through Marion county. Patrick Kelly, G. B. Christian and others are the directors.——A franchise has been granted to H. J. Hill and H. S. Jones for an electric railway in Marion, Monon and Knox counties, the entire line to be about 43 miles in length.

LA PORTE, IND.—Press reports state that P. J. Henson, representing Chicago capitalists, is looking over the field with a view to establishing a street railway system in this city. If the road is built a branch line will be constructed 12 miles north to Michigan City.

BENTON HARBOR, MICH.—It is reported that arrangements are being made for an electric railway from this place to the north and east shores of Paw Paw Lake, by way of Coloma.

HIGHLAND PARK, MICH.—A 30-year franchise for an electric railway 1½ miles in length has been granted to W. H. Muir.

SHERMAN, TEX.—The College Park Electric Belt Line has been sold for $50,000, and it is reported that the new company will build 10 miles of additional road.

MANITOU, COLO.—A company has been formed to construct an electric railway, estimated to cost $50,000; Pres., M. A. Leddy; Secy. and Treas., H. S. Cable.

SMITHS FALLS, ONT.—It is reported that the question of constructing an electric railway from this place to Lanark is being discussed.

HAVANA, CUBA.—The Havana City Ry. Co. was chartered Sept. 26 under the laws of West Virginia, with a capital stock of $1,000,000; charter granted to M. M. Sanchez, 18 Wall St., New York, N. Y.; directors, A. J. Sanchez, Havana; H. Alexander, A. W. Lewis, E. L. Pierson, Brooklyn; H. H. Ross, New York.

HIGHWAYS.

MASSACHUSETTS.—The citizens of Weymouth have petitioned for a town meeting Oct. 14 to discuss the question of appropriating $25,000 for constructing and repairing roads.

MONTANA.—Bids are asked until Oct. 23 for about 17,700 lin. ft. of grading, the work consisting of 5,850 cu. yds. of earth excavation and 25,500 ft. B. M. of pine or fir lumber for culverts. J. S. Tooker, Clk. Bd. County Comrs., Helena.

IDAHO.—The state wagon road commissioners opened bids on Sept. 10 at Boise City as follows, for constructing a road from the mouth of St. Marie River to Wallace: Cameron & Lynch, Spokane, Wash., $17,485; William Payne, $17,000. Ch. Engr., J. W. Birdseye.

BRIDGES.

PHILADELPHIA, PA.—It is reported that the Pennsylvania R. R. Co. will construct a stone bridge across the Conestoga Creek near Safe Harbor station, on the Columbia & Port Deposit R. R. The bridge is to be about 300 ft. long and will cost about $30,000.

WILLIAMSPORT, PA.—The county commissioners received the following bids Sept. 24 for the construction of the Maynard St. bridge, a Pratt truss: Berlin Bridge Co., $26,615; Columbus Bridge Co., $23,575; Brackett Bridge Co., $22,500; Massillon Bridge Co., $21,000; Horseheads Bridge Co., $22,500; King Bridge Co., $24,000; Groton Bridge Co., $19,975; Nelson & Buchanan, $25,400; Oswego Bridge Co., $19,969. The bids for the truss bridge over the log basin were as follows: Berlin Bridge Co., $16,525; Brackett Bridge Co., $14,000; Horseheads Bridge Co., $16,000; King Bridge Co., $12,500; Groton Bridge Co., $9,990; Nelson & Buchanan, $13,866; Oswego Bridge Co., $10,000.

AKRON, O.—The following bids were received Sept. 22 for widening of the North Howard St. bridge: Youngstown Bridge Co., $2,800; Wrought Iron Bridge Co., $2,740; Columbus Bridge Co., $2,725; Massillon Bridge Co., $2,585; Canton Bridge Co., $2,690; King Iron Bridge Co., $2,649; Toledo Bridge Co., $2,750; Iron Superstructure Co., Columbus, $2,760.

SPRINGFIELD, O.—The contract for the construction of a 43-ft. bridge over the Miami River in Madison township has been awarded to the Rogers Iron Co. at $11 per ft.

SAGINAW, MICH.—The supreme court has affirmed the decision of the lower court permitting the city to issue bonds to build the bridges contemplated when the east and west sides of the city were consolidated.

IOWA FALLS, IA.—The 600-ft. Illinois Central railway bridge across the Iowa River at this place was burned Sept. 28. The bridge was built in 1868 and was 75 ft. high.

DULUTH, MINN.—It is stated that preparations are being made to construct the proposed bridge to connect Connor's and Rice's points.

JEFFERSON CITY, MO.—The directors of the Jefferson City Bridge & Transit Co. have accepted the bid for the Missouri Valley Bridge & Iron Wks., Leavenworth, Kan., to construct a bridge over the Missouri River between this city and Cedar City, for $265,000. Of this amount $50,000 has been subscribed as a bonus by private citizens and the remainder will be raised by the bridge and transit company. It is expected that the bridge will be opened for traffic within a year.

DENVER, COLO.—The following bids were received Sept. 20 for building the abutments of the 13th Ave. bridge: Greenlee & Sons, $5,911.84; Eli Ackroyd, $6,954.09; William A. Sheriff, $5,207.88; J. A. McIntyre, $4,005.84; Anthony McDermott, $5,037.20; Olson & French, $6,054.38; J. B. Hindry, $6,166.58.

GOLDEN, COLO.—The council is taking steps to secure the rebuilding of the iron bridge across Clear Creek, on Washington Ave., which was destroyed by high water in June.

WATER-WORKS.

NEW MARKET, N. H.—The construction of works has been commenced.

BLACKSTONE, MASS.—The citizens have voted against contracting with the Blackstone Water Co. for a supply, and no works will be put in at present.

CAMBRIDGE, MASS.—The itemized bids received Aug. 31 for constructing the proposed Payson Park reservoir, with masonry parting wall and concrete floor, were published in our issue of Sept. 20. R. A. Malone, Lancaster, Pa., being the lowest bidder at $145,998. New bids for the work were received Sept. 24, and the lowest was Geo. H. Keyes, Crescent Beach, at $146,016, R. A. Malone bidding $146,941. Only 13 bids were received Sept. 24, the highest being $255,775.

MEDFORD, MASS.—Bids are asked until Oct. 12 for earth work and masonry in construction of a standpipe foundation and for a dam, with gate-house, etc., at Wright's Pond. T. Howard Barnes, Cy. Engr.

LONGMEADOW, MASS.—It is stated that the extension of the Thompsonville (Conn.) Water Co.'s mains to this place, noted in our issue of Sept. 13, will require about seven miles of 8-in. pipe.

WATERBURY, CONN.—Bids are asked until Oct. 9 for trenching and laying a 30-in. water main from North Willow St. to Exchange Place. R. A. Cairns, Cy. Engr.

DEPOSIT, N. Y.—The Deposit Water Co. is considering plans for a better supply, which may cost $20,000.

LONG ISLAND CITY, N. Y.—The city has contracted with the Snow Steam Pump Wks., Buffalo, for a 2,000,000-gallon compound condensing duplex steam pump for the new plant near Woodside.

MIDDLEBURG, N. Y.—It is stated that works will soon be put in. J. Warren Lamb, Cooperstown, is interested.

MORRIS, N. Y.—J. W. Lamb, Cooperstown, has made surveys for works estimated to cost $13,500. H. N. Moore, Secy. Comrs.

MORRISVILLE, N. Y.—The contract for works, as recently advertised in Engineering News, has been awarded to Clinton Beckwith, Herkimer, at $11,456; Engrs., the Stanwix Engineering Co., Rome, N. Y.; Secy. Comrs., D. D. Jones. The bids were as follows:

Engineer's estimate	$12,000
Michael Bennett, Utica, N. Y.	15,381
Sullivan & Mitchell, Norwich, N. Y.	12,145
T. R. Sullivan, College Point, N. Y.	11,999
John Marsden, Utica, N. Y.	11,778
Clinton Beckwith, Herkimer, N. Y.	11,456
T. H. Ryan, Tonawanda, N. Y.	11,450
Donato Cuozzo, New York	11,327
Henry P. Martin, Hamilton, N. Y. (informal)	10,524
J. S. Bull (piping system only), Cortland, N. Y.	7,837

UTICA, N. Y.—It is stated surveys are being made for works, including reservoir, at Hamilton College. Address M. Woolsey Stryker, Pres.

WARSAW, N. Y.—The citizens have voted, 512 to 55, to issue $60,000 in bonds for new works. The present plant is owned by a company and the water rate has recently been increased from $1,000 to $1,500. N. S. Beardslee, Village Pres.

CLAYTON, N. J.—The council has voted to contract with the American Pipe Co., Philadelphia, for 38 fire plugs.

GLASSBORO, N. J.—It is expected that the council will contract with the American Pipe Co. for a supply.

NEWTON, N. J.—At an election Sept. 25 the citizens voted in favor of an additional appropriation of $50,000, making $110,000 in all, for works. Louis L. Tribus, New York, has prepared plans and estimates for a supply from Morris Lake, which is about eight miles distant and 280 ft. higher than the village, estimated to cost $105,000, and also for a supply from Struble's Lake, at an estimated cost of $84,000, but the commissioners have recommended the former. Hiram C. Clark, Chn. Comrs.

SUMMIT, N. Y.—A committee of citizens has employed J. J. R. Croes, New York, to investigate the deficiency of the supply, and he has reported that there has been a manifest failure on the part of the Commonwealth Water Co. to comply with the terms of its contract, and that the trouble has been the result of insufficient number of wells and lack of storage facilities. The company has promised to make the necessary improvements at once.

ALLENTOWN, PA.—Bids are asked until Oct. 10 for the construction of a storage basin about 289 ft. long and 97 ft. wide, the walls to be of concrete 2½ ft. thick and 12 ft. high. Robt. S. Rathbun, Cy. Engr.

CALIFORNIA, PA.—The California Water Co. has been incorporated with a capital stock of $1,000; Treas., O. J. Miller.

COLUMBIA, PA.—The Conewago Water & Power Co. has petitioned for a charter to supply water and water power from Conewago Falls. Cols. Geo. Bratton and Z. S. Boyer are interested.

DOWNINGTON, PA.—The contract for pipe has been awarded to R. D. Wood & Co., and that for a reservoir to E. S. Whitney. The bids for laying the pipes, etc., were as follows:

E. S. Whitney, Allentown	$5,937
M. & T. Farrell, West Chester	6,179
Kay & Coon, Quarryville	6,700
Harmon Davis, Frazer	8,195
Vandergrift & Jacobs, Philadelphia	8,634
R. H. Johnson, Wayne	9,449
Guest & Booth, Downington	9,497
Brown Bros. & Sims	10,500

GERMANIA, PA.—It is reported that the construction of works will be commenced at once.

HAZLETON, PA.—H. Brooks Cellax, Cy. Engr., has completed surveys for a supply from the Nescopeck Creek, at an estimated cost of $216,801 for complete works.

MOUNT HOLLY, PA.—It is stated that a franchise has been granted to R. D. Wood & Co., Philadelphia, and that surveys for works are now being made.

MOUNT JEWETT, PA.—It is reported that the contract for works, to cost about $10,000, has been awarded to D. E. Kendig, Johnsonburg.

PHILADELPHIA, PA.—The following bids have been received for the construction of a filter plant at the Belmont pumping station: New York Filter Co., New York, pressure filter, $231,250, operating expenses for 12 months, $23,000; gravity filter, $206,787, operating expenses for 12 months, $29,500; Robt. Wetherill, Chester, Pa., pressure filter, $240,000, operating expenses for 12 months, $10,000.

READING, PA.—The contract for a new reservoir has been awarded to A. Lincoln Frame, at $11,048. The itemized bids were published last week. Cy.Engr., E. Chamberlain.

WERNERSVILLE, PA.—The Wernersville Water Co. has been incorporated with a capital stock of $15,000; Treas., Geo. F. Knoer.

MARION, VA.—The city is about to contract for a mile of 8-in. pipe, according to reports. A. H. Atkins, Mayor.

BAYARD, W. VA.—It is stated that the town will sell $7,000 in 6% water bonds to build works. Address D. G. Marshall.

MOUNDSVILLE, W. VA.—The construction of works has been commenced by Chas. Rosser, the contractor. Engrs., J. F. Burley & Bro.

ABBEYVILLE, GA.—It is reported that an election will be held this month to vote on an issue of bonds for works.

ELBERTON, GA.—The citizens are reported in favor of issuing $50,000 in bonds for works and an electric light plant.

GRIFFIN, GA.—Bids are asked until Oct. 9 for a water tower 70 ft. high and 30 × 50-ft. tank. W. K. Howard, Supt.

APALACHICOLA, FLA.—There is talk of constructing works. Address W. B. Sheppard, Mayor.

SANFORD, FLA.—The city is negotiating for the purchase or improvement of the works. M. F. Robinson, Chn. Com.

GRENADA, MISS.—The citizens have voted by a majority of seven against an issue of bonds for works.

THIBODAUX, LA.—The contract for works has been awarded to Howard De Long & Co., Lexington, Ky., at $23,000, the other bidders being as follows:

Electrical Mfg. Co., New Orleans, La.	$29,000
Lederle-Taylor Co., Atlanta, Ga.	26,000
New Orleans R. R. & Mill Supply Co.	25,000
Seckner Contracting Co., Chicago, Ill.	30,566
Geo. C. Morgan Co., Chicago, Ill.	24,533
Warner & Co., New Orleans,	24,910

CLEVELAND, O.—The director of public works is reported as stating that one of the important improvements in the near future will be the building of tunnels under the river and canal, at a cost of about $20,000 each, to give the southern part of the city better water service.

COLUMBIANA, O.—It is stated that plans are being prepared for works.

WELLINGTON, O.—The citizens voted Sept. 22 to issue $35,000 in bonds for works, the vote being 419 to 41. No engineer has yet been engaged; population, 2,100. Geo. L. Couch, Mayor.

CRAWFORDSVILLE, IND.—W. P. Haynes, Little Rock, Ark., has been appointed receiver of the Crawfordsville Water & Light Co.

PAOLI, IND.—The Paoli Water-Works Co. has been incorporated by J. Stout, F. H. Braxton, and Aaron Moris; capital stock, $7,000.

DECATUR, MICH.—The question of works is being agitated.

EATON RAPIDS, MICH.—Geo. L. Wells, Bay City, has prepared plans for works estimated to cost $43,000. Address J. J. Milbourne, Cy. Recdr.

MIDLAND, MICH.—The citizens are reported as talking of new works, owing to dissatisfaction with the present service.

MONTAGUE, MICH.—The contract for extensions has been awarded to Chas. S. Dodge, Muskegon, according to reports.

SHELBY, MICH.—An election may be held soon to vote on an issue of $20,000 in bonds for works.

CHICAGO, ILL.—The Carmi Water Co. has been incorporated; capital stock, $5,000; incorporators, A. M. Morgan, Livingston Griffin and F. E. Bradley.

GIBSON CITY, ILL.—Bids are asked until Oct. 18 for constructing works, as stated in our advertising columns. Consult. Engr., John A. Cole, Chicago. T. D. Spalding, Mayor.

NOKOMIS, ILL.—It is stated that $8,000 in bonds will be issued for works.

O'FALLON, ILL.—The O'Fallon Water & Electric Light Co. is reported to have awarded contracts for its plant.

PEORIA, ILL.—The committee has decided to recommend that the East Bluff tower and stand-pipe be removed and rebuilt.

ROSSVILLE, ILL.—Bids are asked until Oct. 12 for constructing works (postponement of date from Oct. 1). S. W. McGuire, Village Clk.

VANDALIA, ILL.—Bids are asked until Oct. 18 for constructing works, as stated in our advertising columns. Consult. Engr., Hiram Phillips, St. Louis. Geo. Steinhauer, Mayor.

REEDSBURG, WIS.—The contract for works has been awarded to P. McDonald, Duluth, and that for the electric light plant to the National Electric Light Co., Eau Claire, according to press reports.

CLARKSVILLE, IA.—Geo. Ilgenfret, Cy. Clk., informs us that the contract for works has been awarded to the Challenge Wind Mill & Feed Mill Co., at

$7,180, the other bidders being the U. S. Wind Engine & Pump Co., Batavia, Ill., $8,200; Smedley Mfg. Co., Dubuque, $8,375; B. Schomer, Des Moines, $9,100.

DAYTON, IA.—The council has adopted the plans of F. S. Hoyt for a system. The construction of a well 90 ft. deep has been commenced and about a mile of mains will be put in this fall.

PIERSON, IA.—A supply is being secured for fire protection, according to reports.

SUMNER, IA.—It is reported that works will be put in soon.

DULUTH, MINN.—An election will be held Oct. 26 to vote on the proposed purchase of the plant of the Duluth Gas & Water Co. The resolution adopted by the council calls for an issue of $2,100,000 in bonds for the purchase of the plant and $600,000 for extensions.

NELSON, NEB.—A. A. Richardson, Lincoln, Neb., is preparing plans for works. The election to vote bonds will be held Oct. 26.

RUSSELLVILLE, ARK.—The "Express" urges that works and electric lights be put in.

MONTICELLO, ARK.—It is reported that the citizens want works.

SILOAM SPRINGS, ARK.—It is stated that the council will soon be petitioned for a franchise for works.

PANHANDLE, TEX.—It is stated that Al Moore, Newton, Kan., has been awarded a contract for a large reservoir in this city, for the Atchison, Topeka & Santa Fe R. R. Co.

STEPHENVILLE, TEX.—It is reported that contracts will soon be awarded for the proposed works. Address Jas. Beech.

LOUISVILLE, COLO.—D. Mitchell & Co., Pueblo, have been awarded the contract for works estimated to cost $30,000, and will commence the construction at once, according to reports.

SILVER PLUME, COLO.—The contract for works has been awarded to Sopp, Truscott & Myers, Silver Plume, who will take $20,000 in town bonds in payment.

ASTORIA, ORE.—The commissioners are reported as about to sell $200,000 in bonds for new works, to be built as soon as possible.

DAYTON, ORE.—There is talk of securing a gravity supply.

BERKELEY, CAL.—A shortage is reported in the water supply, and the building of a new pumping station near the bay is projected.

BARTONVILLE, ONT.—John W. Gage and others are agitating the question of works, according to reports.

BEANSVILLE, ONT.—It is reported that efforts are being made to secure works.

RAT PORTAGE, ONT.—Messrs. Deacon and Wm. Kennedy, Jr., of Owen Sound, have prepared plans for works estimated to cost $50,000, and it is reported that an election will soon be held to vote on the question of construction.

WINNIPEG, MAN.—The "Free Press" states that the contract for the new water-works buildings has been let by Charles Wheeler, architect, to Bourke & Cass, at about $8,000. The buildings include a new filter house, pump house and boiler house.

ARTESIAN WELLS.

FARGO, N. DAK.—Bids are asked until Oct. 20 for sinking a 6-in. artesian well at the state agricultural college, 1½ miles from Edgerley, N. Dak. J. B. Power, Secy. Bd. Trustees.

IRRIGATION.

SAN BERNARDINO, CAL.—Press reports from this city state that A. P. McGinnis, receiver of the Bear Valley Reservoir Co., left the city Sept. 21 with a large force of men for Bear Valley Lake. D. P. N. Little, Los Angeles, has taken a contract to clear the reservoir of standing timber and debris, preparatory to the construction of a new dam next year. A Chicago, English and Scotch syndicate on Oct. 8 will, at public sale, under order of the court, buy out the entire plant. The syndicate is backed by $2,500,000. A new dam 90 ft. high will be erected next spring and canals, pipe lines and ditches will be built this winter. The new reservoir will contain five times the water of the old dam, or a continuous flow of 14,000 ins., with a hold over of the same amount for the next season. This will irrigate every foot of unoccupied land in San Bernardino and Perris valleys. The new company proposes to operate a car line and works with electricity developed by water power at the dam site.

SEWERS.

AMESBURY, MASS.—J. T. Clarkson, J. A. Douglass, W. H. B. Currier and others have been appointed to consider the question of completing the system and to report in March.

DANVERS, MASS.—The board of health is considering plans for constructing a sewer to remove the sewage from Crane River.

NATICK, MASS.—The committee has engaged S. M. Gray, Providence, R. I., as consulting engineer of the new system about to be constructed.

NEW BEDFORD, MASS.—The council is discussing a communication of the board of public works asking for an appropriation of $22,000 for lowering 1,210 ft. of sewer in Purchase St.

BROOKLYN, N. Y.—Bids are asked until Oct. 12 for constructing sewers in three districts. A. T. White, Comr. Cy. Wks.

NEW YORK, N. Y.—Bids are asked by the commissioner of street improvements, 2622 Third Ave., until Oct. 9 for constructing a sewer in Trinity Ave.

HOBOKEN, N. J.—The city engineer has been directed to prepare plans for an outlet sewer for the meadow district.

CRANFORD, N. J.—The township committee has voted to build a sewer to tidewater at an estimated cost of $60,000.

TRENTON, N. J.—Bids are asked until Oct. 16 for constructing several sewers. C. E. Murray, Cy. Clk.

ERIE, PA.—The council is discussing an ordinance for constructing 2,344 ft. of 36-in. brick sewers, estimated to cost $23,440, and 2,341 ft. of 24-in. pipe sewers, estimated to cost $12,407.

OROFTON, PA.—The council and board of health are discussing a plan for a sewer proposed by Dr. W. R. Foster, Pres. Bd. of Health. The sewer would be seven miles in length and would drain Carnegie, Glendale, Heidelberg and other towns, and is estimated to cost about $160,000.

LORAIN, PA.—The Johnson Co. has engaged G. E. Waring to prepare plans for a system at the steel works.

McKEE'S ROCKS, PA.—Bids are asked until Oct. 6 for making surveys, plans, etc., for a system. Wm. Linkham, Chn. Com.

READING, PA.—The mayor has approved of the ordinance appropriating $82,000 for constructing a sewage disposal plant.

SAVANNAH, GA.—Plans are being prepared by Capt. G. D. Purse, for a complete system.

HENDERSON, KY.—The plans for a system prepared by G. E. Waring have been received by the city engineer. The system is estimated to cost $187,000.

HAMILTON, O.—The commission has recommended the construction of lateral sewers in Ward 2.

WARREN, O.—Bids are asked until Oct. 22 for constructing 4,000 ft. of 20 to 15-in. pipe sewers; average cut, 8½ ft. A. E. Andrews, Cy. Clk.

GRAND RAPIDS, MICH.—The contract for constructing the Coldbrook trunk sewer has been awarded to J. & Albert Prange at $44,890; city engineer's estimate, $50,200; highest bid, $68,685.

LANSING, MICH.—The board of public works has been directed to advertise for bids for constructing a sewer in Washington Ave. It is also proposed to construct sewers in several other streets.

OCONTO, WIS.—A sewerage system is to be constructed. Ch. Engr., W. F. Goodhue, Milwaukee, Wis.

RIPON, WIS.—A system is to be constructed. Engr., W. F. Goodhue, Milwaukee, Wis.

KANSAS CITY, KAN.—The council has passed an ordinance for constructing a sewer in district No. 15, estimated to cost $14,800.

GRANT'S PASS, ORE.—An election is to be held Oct. 8 to vote on the question of issuing $22,000 in bonds for a system.

MONTREAL, QUE.—The road committee has recommended the construction of a sewer to drain St. Denis Ward, to be about three miles long and estimated to cost $132,000.

STREETS.

PROVIDENCE, R. I.—Resolutions have been passed by the council for constructing portions of five streets at an estimated cost of $17,500, and for building concrete sidewalks in five other streets.

BINGHAMTON, N. Y.—The council is reported about to repave Commercial Ave.

BROOKLYN, N. Y.—Bids are asked until Oct. 11 for repaving four streets with asphalt. A. T. White, Comr. Cy. Wks.—The property owners of Ward 18 have petitioned for the paving of a portion of Metropolitan Ave. with granite blocks. Frank Schulz and T. R. Chapman are interested.—The Portland Cement Paving & Construction Co. has been incorporated with a capital stock of $3,000; directors, W. G. Triest, New York; Emil Agreek, Stapleton; H. J. Kreuzweiser, Brooklyn.

NEW YORK, N. Y.—Bids are asked by the department of public works until Oct. 15 for grading and paving one street with asphalt and for grading and curbing two streets; also for constructing sewers in two streets.

CHESTER, PA.—The Delaware County Paving & Construction Co. has been organized with a capital stock of $50,000. Councilman Dickerson is president of the company.

PIQUA, O.—Bids are asked until Oct. 19 for constructing sidewalks, etc., in five streets. H. E. Whitlock, Cy. Engr.

INDIANAPOLIS, IND.—The board of public works has ordered that a portion of Alabama St. be paved with asphalt, and the construction of about 1½ miles of cement, asphalt and brick sidewalks.

JEFFERSON, IND.—The estimated cost of paving Spring St. with brick is $35,000.

PONTIAC, MICH.—The repaving of Saginaw St. is being discussed.

PEORIA, ILL.—Isaac Taylor, Comr. Pub. Wks., has recommended that eight miles of brick and seven miles of asphalt paving be laid. During this year about five miles of brick and asphalt paving has been constructed and about 15 miles of sewers.

KANSAS CITY, MO.—The council has passed resolutions for paving and improving 14 streets.

ELECTRIC LIGHT AND POWER.

BARNET, VT.—The question of putting in an electric plant in this place is being agitated.

HAMILTON, N. Y.—The citizens have voted to put in an electric light plant.

ROME, N. Y.—Bids are asked until Oct. 15 for 150 arc lights of 2,000 c. p., for one, three or six years. K. S. Putnam, Chamberlain; C. A. Fowler, Chn. Com.

SANDY HILL, N. Y.—J. H. Derby, S. H. Kenyon and J. J. Cunningham, of the Sandy Hill Electric Light Co., have been appointed to consider plans for a new building for the plant. Water will be used for motive power.

MILLERSTOWN, PA.—The question of putting in an electric light plant is being discussed.

WESTMINSTER, MD.—The Schlosser Tannery Co. near this town, is reported about to put in an electric light plant of 75 lights.

CUTHBERT, GA.—Bids are asked until Oct. 15 for the purchase of $10,000 of 6% bonds for an electric light plant. R. L. Moye, Mayor.

LAWRENCEBURG, KY.—A contract has been awarded to G. L. Hogan, Chicago, to furnish this place with electric lights.

COLUMBUS, O.—The trustees of the state university have issued $100,000 in bonds for an electric light plant.

GRAND RAPIDS, MICH.—The council has voted to issue $150,000 in bonds for an electric light plant.

KALAMAZOO, MICH.—The citizens will vote again in November on the question of issuing bonds for a municipal electric light plant.

CHICAGO, ILL.—The following are the lowest bids received by the commissioner of public works for constructing a new electric light station on South Halstead St.: Busse & Gleason, $15,000, and E. F. Gobel, $15,583; for steel roofs the lowest bids were: Kenwood Bridge Co., $3,599, and C. L. Strobel, $3,600.

LAKE CITY, IA.—A franchise for an electric light plant has been granted to E. B. Hillman & Co.

MINNEAPOLIS, MINN.—The council has decided to let the citizens vote on the question of issuing $300,000 in bonds for an electric light plant.

STEPHENVILLE, TEX.—It is reported that bids for an electric light plant are being received by James Beech.

SPOKANE, WASH.—It is reported that this city is figuring on putting in a city electric light system, by substituting dynamos for one of the pumps at the water-works power house. The plant would cost $40,000. The city pays $8 per light for arc lights, and it is claimed it could in this way get them for $4.50.

GERVAIS, ORE.—It is reported that this place is considering estimates for an electric light plant.

LEBANON, ORE.—The council is discussing the question of issuing bonds for the purchase of the electric light and water plant.

PARRSBORO, N. B.—A company has been organized with a capital stock of $10,000 to put in an electric light plant.

STRATFORD, ONT.—The council has adopted an ordinance for constructing a combined electric light station and fire hall estimated to cost, with the plant, about $16,000.

NEW COMPANIES.—Wadsworth General Electric Co., Wadsworth, O.; $10,000; W. B. Hunsberger, J. A. Clark, A. M. Beck, O. V. Dibble.—Garven Electrical Mfg. Co., Portland, Ore.; $5,000; W. H. Garven, Thomas Hawes, S. J. Barber.—Westlake Electrical Mfg. Co., East St. Louis, Ill.; $100,000; C. T. Westlake, David Riggs, C. C. Collins.—Mount Carroll Electric Light Co., Mount Carroll, Ill.; $12,800; O. P. Miles, W. Q. Sayers.—American Electric Smelting Co., Wheeling, W. Va.; $1,000,000.—Citizens' Electric Co., Springfield, Ill.; $60,000.—New London Electric Light Co., New London, O.; $4,000; D. J. S. Arnold, H. G. Skinner, C. E. Reynolds, O. J. Carter.—Electric Power Co., Los Angeles, Cal.; $1,000,000; E. C. Seymour, Peter Kehl, San Bernardino; M. L. Graff, H. W. Latham, Los Angeles.—Cumberland Light, Heat & Power Co., Mechanicsburg, Pa.; $50,000; Treas., J. D. Landes.—Pacific Electrical Co., San Francisco, Cal.; $30,000; W. S. Beckwith, P. E. Rickey, F. H. Kimball, John T. Hogan.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

GARBAGE CREMATORY.—Camden, N. J.—The council has voted to appropriate $10,000 for a garbage crematory.

DRAINAGE.—Mount Vernon, N. Y.—Bids are asked until Oct. 27 for about 5¼ miles of drainage work, as stated in our advertising columns. Engr., J. F. Fairchild.

MODEL BARGES.—St. Louis, Mo.—Bids are asked until Oct. 24 for furnishing 12 model barges, as stated in our advertising columns. Maj. Chas. J. Allen, U. S. Engr. Office.

DITCH.—Marion, O.—Bids are asked until Oct. 9 for the construction of the Columbia St. county ditch improvement, as stated in our proposal columns. H. J. Hill, Constr. Engr.

JETTY WORK.—New Orleans, La.—Bids are asked until Oct. 25 for capping jetty with stone for improving mouth and passes of Calcasieu River. Maj. Jas. B. Quinn, U. S. Engr. Office.

ARMORY BUILDING.—New York, N. Y.—Bids are asked until Oct. 10 for the erection of an armory building on 14th St., near Sixth Ave. Address the secretary of the armory board, 280 Broadway.

BREAKWATER AND PIER WORK.—Milwaukee, Wis.—Bids are asked until Nov. 6 for extending breakwater and piers, as stated in our advertising columns. Maj. Jas. F. Gregory, U. S. Engr. Office.

DREDGING AND JETTY WORK.—New Orleans, La.—Bids are asked until Oct. 29 for extension of East jetty and for dredging at harbor of Sabine Pass, Tex. Maj. Jas. B. Quinn, U. S. Engr. Office.

TELEPHONE FRANCHISE.—Brazil, Ind.—The Interstate Telephone Co. has been granted a 20-year franchise by the city. The plant is to be in operation in six months, and the rates are to be $2.50 per month for business houses and $2 for residences.

DREDGING, ETC.—Milwaukee, Wis.—Bids are asked until Nov. 1 for dredging and pier and breakwater construction, as stated in our advertising columns. Maj. Jas. F. Gregory, U. S. Engr. Office.

Philadelphia, Pa.—Bids are asked until Nov. 2 for dredging, as stated in our advertising columns. Maj. C. W. Raymond, U. S. Engr. Office.

LEVEE WORK.—Memphis, Tenn.—Bids are asked until Oct. 9 for the construction of a levee in the vicinity of Walnut Bend, Ark. 1st Lieut. J. C. Sanford, U. S. Engr. Office.

New Orleans, La.—Bids are asked for the following levee work: Until Oct. 10, Atchafalaya district, about 563 cu. yds.; Oct. 11, Lafourche district, 245,500 cu. yds.; Pontchartrain district, 204,000 cu. yds.; Oct. 12, Lower Tensas district, 27,000 cu. yds.; Barataria district, 110,700 cu. yds.; Lake Borgne district, 91,000 cu. yds. Capt. John Millis, U. S. Engr. Office.

CANALS.—Crowley, La.—It is stated that Warner & Co., New Orleans, have been awarded the contract for building the canal from Bayou Queue Tortue down into the Gueydon lands. A company has been formed with a capital stock of $100,000, of which $40,000 has been paid in. The canal will be 81 ft. wide at the water line, and 4 ft. deep. The engineer in charge will be on the ground Oct. 1. Work will commence on the first five miles, Oct. 15. The pumping plant will consist of six 15-in. Morey pumps, 500-HP. engine, with a guaranteed capacity of 46,200 gallons per minute.

Elkhart, Ind.—Press reports state that a corps of engineers have just completed a trip up the St. Joseph

River and its branches, in the interest of Toledo capitalists who propose to build a canal to Chicago. The line of the canal route, as shown by the survey, is from Chicago across Lake Michigan to Michigan City, to Elkhart, through a series of lakes and rivers, to the Maumee close to the state line, down the Wabash Canal, taking in Defiance and Napoleon, O., and making Toledo the terminus. Dr. W. T. Harris has been making an exhaustive study of the subject and has made an actual survey of the territory which such canal would cover. His investigation has made him a firm believer in the future of such a project.

LIGHT STATION.—Baltimore, Md.—The following bids were received by Capt. Eric Bergland, U. S. Lighthouse Engr., for furnishing material and construction of the Solomons Lump lighthouse, Chesapeake Bay, Md.:

	Metal work.	Construction
Maryland Steel Co., Sparrows Point, Md	$15,000	...
Allentown Rolling Mills, Allentown, Pa.	9,950	.....
Sooysmith & Co., New York	....	$20,000
Vulcan Iron Wks., Chicago, Ill.	10,340	.....
Russel Wheel & Frdy Co., Detroit, Mich.	11,789	.....
Weimer Machine Wks. Co., Lebanon, Pa.	9,214	.....
Tacony Iron & Metal Co., Tacony, Pa.	10,300	.....
N. J. Steel & Iron Co., Trenton, N. J.	11,143	.....
Phoenix Iron Co., Philadelphia, Pa.	16,223	.....
Wheeler Condenser & Eng. Co., Carteret	14,046	.....
Robt. Poole & Son Co., Baltimore, Md.	10,000	.....
John P. McGuire, Cleveland, O.	7,500	.....
I. H. Hathaway & Co., Philadelphia, Pa.	....	29,300
Richmond Iron Wks., Richmond, Va.	7,274	.....
Wm. H. Flaherty, New York	....	17,200

CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

Bids to be opened.	Work.	Place.	See Eng. News.
Oct. 5.	Breakwater repairs,	Burlington, Vt.	Sept. 6
	Advertised, Eng. News, Sept. 6 to 27.		
Oct. 5.	Dredging (2 contracts),	Burlington, Vt.	Sept. 6
	Advertised, Eng. News, Sept. 6 to 27.		
Oct. 5.	Rock excavation,	Burlington, Vt.	Sept. 6
	Advertised, Eng. News, Sept. 6 to 27.		
Oct. 5.	Electric fixtures, etc.,	Denver, Colo.	Sept. 13
Oct. 5.	Land reclamation,	Islip, N. Y.	Sept. 20
	Advertised, Eng. News, Sept. 20 and 27.		
Oct. 5.	Levee work,	Memphis, Tenn.	Sept. 27
Oct. 6.	Arch culvert,	Cincinnati, O.	Sept. 20
Oct. 6.	Macadamizing,	Norwood, O.	Sept. 20
Oct. 6.	Water bonds,	Fulda, Minn.	Sept. 27
Oct. 8.	Rubble stone,	Boston, Mass.	Sept. 13
	Advertised, Eng. News, Sept. 13 to 27.		
Oct. 8.	Dredging,	Boston, Mass.	Sept. 13
	Advertised, Eng. News, Sept. 13 to 27.		
Oct. 8.	Ledge work,	Boston, Mass.	Sept. 27
Oct. 8.	Crosswalks, etc.,	Collinwood, O.	Sept. 27
Oct. 6.	Sewer plans,	McKee's Rocks, Pa.	Oct. 4
Oct. 8.	Sidewalk improvements,	Muncie, Ind.	Sept. 27
Oct. 8.	Pipe sewers,	South Bend, Ind.	Sept. 27
Oct. 8.	Paving,	South Bend, Ind.	Sept. 27
Oct. 8.	Water bonds ($400,000),	Portland, Ore.	Sept. 27
Oct. 9.	Electric lighting,	Cynthiana, Ky.	Sept. 20
	Advertised, Eng. News, Sept. 20 and 27.		
Oct. 9.	Buildings, etc.,	Washington, D. C.	Sept. 13
	Advertised, Eng. News, Sept. 13 to 20.		
Oct. 9.	Paving (8 streets),	Buffalo, N. Y.	Sept. 27
Oct. 9.	Culvert,	Des Moines, Ia.	Sept. 27
Oct. 9.	Sewer,	New York, N. Y.	Oct. 4
Oct. 9.	Water tower,	Griffin, Ga.	Oct. 4
Oct. 9.	Levee work,	Memphis, Tenn.	Oct. 4
Oct. 9.	Laying 30-in. pipe,	Waterbury, Conn.	Oct. 4
Oct. 9.	Ditch,	Marion, O.	Oct. 4
	Advertised, Eng. News, Sept. 27 and Oct. 4.		
Oct. 10.	Sewer pipe,	Jacksonville, Fla.	Sept. 20
	Advertised, Eng. News, Sept. 20 to Oct. 4.		
Oct. 10.	Iron bridges,	Sherman, Tex.	Sept. 20
Oct. 10.	Stand-pipe,	Lyons, Neb.	Sept. 27
Oct. 10.	Armory building,	New York, N. Y.	Oct. 4
Oct. 10.	Storage basin,	Allentown, Pa.	Oct. 4
Oct. 10.	Levee work,	New Orleans, La.	Oct. 4
Oct. 11.	Pumping engines,	Chicago, Ill.	Sept. 20
	Advertised, Eng. News, Sept. 13 to 27.		
Oct. 11.	Dredging (2 contracts),	Norfolk, Va.	Sept. 1.
	Advertised, Eng. News, Sept. 13 to Oct. 4.		
Oct. 11.	Dredging,	New York, N. Y.	Sept. 20
	Advertised, Eng. News, Sept. 20 to Oct. 11.		
Oct. 11.	Dredging,	Baltimore, Md.	Sept. 20
	Advertised, Eng. News, Sept. 20 to Oct. 4.		
Oct. 11.	Dredging,	New York, N. Y.	Sept. 27
Oct. 11.	Asphalt paving,	Brooklyn, N. Y.	Oct. 4
Oct. 11.	Levee work,	New Orleans, La.	Oct. 4
Oct. 12.	Public building,	Allegheny, Pa.	Sept. 20
	Advertised, Eng. News, Sept. 20 and 27.		
Oct. 12.	Removing rock, etc.,	Detroit, Mich.	Sept. 20
Oct. 12.	Highway (6,500 lin. ft.),	Helena, Mont.	Sept. 27
Oct. 12.	Water bonds,	Lyle, Minn.	Sept. 27
Oct. 12.	Water-works system,	Humboldt, Neb.	Sept. 27
Oct. 12.	Water bonds,	Humboldt, Neb.	Sept. 27
Oct. 12.	Stand-pipe f'ndat'n, etc.,	Medford, Mass.	Oct. 4
Oct. 12.	Sewers,	Brooklyn, N. Y.	Oct. 4
Oct. 12.	Water-works system,	Rossville, Ill.	Sept. 20
Oct. 12.	Levee work,	New Orleans, La.	Oct. 4
Oct. 13.	Sewer pipe, etc.,	Washington, D. C.	Sept. 27
	Advertised, Eng. News, Sept. 27 and Oct. 4.		
Oct. 15.	Hire of dredging plant,	Buffalo, N. Y.	Sept. 20
	Advertised, Eng. News, Sept. 20 to Oct. 4.		
Oct. 15.	Dredging,	New York, N. Y.	Sept. 27
	Advertised, Eng. News, Sept. 27 to Oct. 11.		
Oct. 15.	Water bonds ($40,000),	Cuthbert, Ga.	Sept. 27
Oct. 15.	Sewer bonds ($500,000),	San Antonio, Tex.	Sept. 27
Oct. 15.	Capitol bldg. foundation,	Olympia, Wash.	Sept. 27
Oct. 15.	Dredging,	Portland, Me.	Sept. 27
	Advertised, Eng. News, Sept. 27 to Oct. 11.		
Oct. 15.	Electric lighting,	Rome, N. Y.	Oct. 4
Oct. 15.	Asphalt paving,	New York, N. Y.	Oct. 4
Oct. 15.	Electric light bonds,	Cuthbert, Ga.	Oct. 4
Oct. 15.	Grading,	New York, N. Y.	Oct. 4
Oct. 16.	Pumps and reservoirs,	Beaver Falls, Pa.	Sept. 13
	Advertised, Eng. News, Sept. 13 to 27.		
Oct. 16.	Dredging,	New York, N. Y.	Sept. 27
	Advertised, Eng. News, Sept. 27 to Oct. 11.		
Oct. 16.	Breakwaters,	New York, N. Y.	Sept. 27
	Advertised, Eng. News, Sept. 27 to Oct. 11.		
Oct. 16.	Steel rails,	Ottawa, Ont.	Sept. 27
Oct. 16.	Sewers,	Brooklyn, N. Y.	Oct. 4
Oct. 17.	Electric lighting,	Oswego, N. Y.	Sept. 20
Oct. 17.	Riprap stone,	Washington, D. C.	Sept. 20
	Advertised, Eng. News, Sept. 20 to Oct. 11.		
Oct. 17.	Dredging,	Washington, D. C.	Sept. 20
	Advertised, Eng. News, Sept. 20 to Oct. 11.		
Oct. 18.	Dredging (300,000 cu.yds.),	New York.	Sept. 27
Oct. 18.	Pile revetment (500 ft.),	New York, N. Y.	Sept. 27
Oct. 18.	Water-works system,	Gibson City, Ill.	Oct. 4
	Advertised, Eng. News, Oct. 4 and 11.		
Oct. 18.	Water-works system,	Vandalia, Ill.	Oct. 4
	Advertised, Eng. News, Oct. 4 and 11.		
Oct. 19.	Jail cells, etc.,	Auburn, Cal.	Sept. 27
Oct. 19.	Sidewalks,	Piqua, O.	Oct. 4
Oct. 20.	Artesian well,	Fargo, N. Dak.	Oct. 4
Oct. 22.	Water supply,	Jersey City, N. J.	Sept. 20
Oct. 22.	Ledge work,	Boston, Mass.	Sept. 27
	Advertised, Eng. News, Sept. 27 to Oct. 11.		
Oct. 22.	Water bonds ($15,000),	Attica, O.	Sept. 27
Oct. 22.	Pipe sewers, (4,000 ft.),	Warren, O.	Oct. 4
Oct. 23.	Approaches, etc.,	Detroit, Mich.	Sept. 27
	Advertised, Eng. News, Sept. 27 and Oct. 4.		
Oct. 23.	Grading, etc.,	Helena, Mont.	Oct. 4
Oct. 24.	Heating apparatus,	New Haven, Conn.	Sept. 27
	Advertised, Eng. News, Sept. 27 and Oct. 4.		
Oct. 24.	Model barges,	St. Louis, Mo.	Oct. 4
	Advertised, Eng. News, Sept. 27 to Oct. 11.		
Oct. 25.	Granite,	St. Augustine, Fla.	Sept. 27
	Advertised, Eng. News, Sept. 27 to Oct. 18.		
Oct. 25.	Jetty work,	New Orleans, La.	Oct. 4
Oct. 27.	Drainage,	Mount Vernon, N. Y.	Oct. 4
	Advertised, Eng. News, Oct. 4 and 11.		
Oct. 29.	Dredging and jetty work,	New Orleans.	Oct. 4
Oct. 31.	Drawbridges,	Chicago, Ill.	Sept. 6
	Advertised, Eng. News, Sept. 6 and 20.		
Oct. 31.	Bridge masonry,	Chicago, Ill.	Sept. 6
	Advertised, Eng. News, Sept. 6 and 20.		
Nov. 1.	Dredging, piers, etc.,	Milwaukee, Wis.	Oct. 4
	Advertised, Eng. News, Oct. 4 to 25.		
Nov. 2.	Dredging,	Philadelphia, Pa.	Oct. 4
	Advertised, Eng. News, Oct. 4 to 25.		
Nov. 6.	Filter plant,	Beaver Falls, Pa.	Sept. 13
	Advertised, Eng. News, Sept. 13 to 27.		
Nov. 6.	Breakwater and piers,	Milwaukee, Mis.	Oct. 4
	Advertised, Eng. News, Oct. 4 to 25.		
No date.	Canal work,	Los Angeles, Cal.	Sept. 13
	Advertised, Eng. News, Sept. 13 to Oct. 18.		
"	" Electric light plant,	Lisbon, Ia.	Sept. 20
	Advertised, Eng. News, Sept. 20.		
"	" Water-wks. system,	Lisbon, Ia.	Sept. 20
	Advertised, Eng. News, Sept. 20.		
"	" Artesian well,	Gibson's Station, N. C.	Sept. 27
"	" Irrigation canal,	Great Bend, Kan.	Sept. 27

CONTRACT PRICES.

PIER WORK, ETC.—Chicago, Ill.—The following bids were received by Capt. W. L. Marshall, U. S. Engr. Office, Sept. 25 for rebuilding and repairing superstructure of exterior breakwater, Chicago Harbor, and for rebuilding superstructure of pires, Calumet Harbor:

Bids for Pier and Breakwater Work in Chicago and Calumet Harbors.

Bidder.	Chicago Harbor. Pine timber, 1,481,000 ft., per M. ft.	Decking, 901,692 ft.	Bolts, 154,965 lbs.	Spikes, 54,000 lbs.	Stone, 798.8 per cord.	Total.	Calumet Harbor. Pine timber, 295,800 ft.	Drift bolts, 34,980 lbs., per lb.	Stone, 60 cords, per cord.	Total.
Donald A. McLeod, Manistee, Mich.	$25.00	$16.00	$0.0225	$0.03	$6.00	$61,362	$25.50	$0.0235	$6.00	$8,725
Wis. Dredge & Dock Co., Manitowoc.	24.00	16.00	.021	.019	5.00	58,260	26.00	.021	6.00	8,785
Honsler & Lutz, South Chicago, Ill.	....	....	....	....	....	....	23.70	.04	7.00	8,830
A. B. Kerr & Co., Chicago, Ill.	25.75	17.50	.02	.03	5.25	62,844	25.50	.02	5.25	8,557
Shaller & Schniglau Co., Chicago, Ill.	26.90	18.25	.018	.02	5.22	64,350	27.50	.02	5.50	9,164
Lydon & Drews, Chicago, Ill.	28.35	16.75	.021	.025	4.75	65,505	27.00	.03	5.00	9,336
Fitzsimons & Connell Co., Chicago, Ill.	21.50	18.00	.02	.025	5.00	56,528	21.50	.02	6.00	7,419
Green's Dredging Co., Chicago, Ill.	26.00	21.00	.04	.04	5.25	70,009	....	....	....	....
Geraldine & Derbyshire,, Chicago, Ill.	24.20	13.75	.0225	.0265	5.80	57,804	24.20	.0225	6.00	8,305
Kimbell & Cobb Stone Co., Chicago, Ill.	27.75	20.00	.0275	.03	5.00	69,024	26.75	.0275	6.50	9,265

PUMPING ENGINES.—Pittsburg, Pa.—Local papers state that the following bids were received Sept. 21 for two or four new high grade pumping engines of about 12,000,000 gallons capacity each, the contract being awarded Sept. 29 to the E. P. Allis Co., at $173,000:

	For 2.	For 4.
Edward P. Allis Co.	$173,000	$330,000
Henry R. Worthington	173,500	338,000
Wilson, Snyder & Co.	175,400	350,980
Holly Mfg. Co.	191,640	374,000

ASPHALT PAVING.—Jersey City, N. J.—The only bid received for paving Park St., from Communipaw Ave. to Astor Place, with asphalt upon 4 ins. concrete was that of the Barber Asphalt Paving Co., as follows: Earth excavation, 20 cts. per cu. yd.; rock excavation, $1 per cu. yd.; sand or gravel filling, $1.10 per cu. yd.; new stone curbing, 45 cts. per lin. ft.; new flagging, 13 cts. per sq. ft.; repaving, 25 cts. per sq. yd.; resetting curbing, 5 cts. per lin. ft.; relaying bridge stone, 4 cts. per sq. ft.; relaying flagging, 1 ct. per sq. ft.; receiving basins, $75 each; bringing manhole heads to grade, $1 each; asphalt paving on 4 ins. concrete, $2.62 per sq. yd.

GARBAGE CREMATORY.—St. Paul, Minn.—The following bids were received Sept. 28 for the erection of a garbage crematory to cremate 100 tons of garbage each 24 hours, and for the operation of the same for one year: Thos. Manning, a Dixon crematory, $29,500 per year; W. J. Preston, no crematory specified, $23,864; I. A. Grant, a Dixon crematory, $28,500.

STAND-PIPE.—Medford, Mass.—The following bids were received Oct. 1 for the erection of a steel standpipe, 35 × 60 ft., according to press reports: R. D. Wood & Co., Philadelphia, $7,335; Rantoon Boiler Co., Syracuse, N. Y., $5,980; Tippett & Wood, Phillipsburg, N. J., $5,987; Cunningham Iron Wks., Boston, $5,540; Riter & Conley, Pittsburg, $5,665; Davis & Farnum Mfg. Co., Waltham, $5,800; Walsh's Steam Boiler Wks., Holyoke, $4,745; E. Hodge & Co., East Boston, $5,000.

JETTIES.—Savannah, Ga.—The following bids were received at the U. S. Engineer Office last week for constructing jetties at Cumberland Sound:

	Mattresses, sq.yd.	Stone, cu.yd.	Total.
Anson M. Bangs, Fayetteville, N.Y.	$0.57	$2.00	$88,500
R. G. Ross & Co., Jacksonville, Fla.	.85	2.85	128,000
Rittenhouse Moore & Co., Mobile, Ala.	.90	2.90	129,000

STONE.—Nashville, Tenn.—Capt. John Biddle, U. S. Engr. Office, received the following bids Sept. 25 for supplying stone for masonry of lock No. 2, Cumberland River, the price being given per cubic yard:

Bids for Furnishing Stone for Lock No. 2, Delivered on Barges in Cumberland River.

Bidder.	Sills, 93 cu yds.	Hollow quoins, 98 cu.yds.	Special stones, 200 cu.yds.	Coping, 350 cu.yds.	Pointed faced face, 2,000 cu.yds.	Squared faced rubble, 1,320 cu.yds.	Backing, 7,000 cu.yds.	Total.
Patterson & Shipman, Washington, D. C.	$15.00	$25.00	$14.00	$14.00	$9.50	$8.00	$7.50	$93,605
Petitdidier & Allen, Nashville, Tenn.	15.50	21.00	13.50	13.50	10.00	4.50	3.00	57,864
H. P. McDonald, Louisville, Ky.	16.00	16.00	13.90	13.50	9.95	6.60	4.00	67,173
P. H. McCormack, Columbus, Ind.	20.00	25.00	16.50	20.00	10.50	7.00	5.00	79.850
Salem-Bedford Stone Co., Louisville, Ky.	14.40	15.40	14.40	13.90	12.25	11.54	9.59	117,656
Foster & Creighton, Nashville, Tenn.	16.80	19.85	14.35	16.00	12.40	5.70	4.70	77,202

Portland, Ore.—The following bids were opened at the U. S. Engineer Office, Sept. 22, for furnishing 100,000 tons of rock to be used in the construction of the jetty at the mouth of the Columbia River: John Kiernan, Portland, 48 cts. per ton, stone to be furnished from Fisher's Landing (awarded contract); Pomeroy & Smith, Oswego, Ore., 56½ cts. per ton, stone from Murhard's quarry; Paquet & Messinger, Portland, 59 cts. per ton, stone from Wiberg's quarry; McKenzie & Glin, Portland, 53 cts. per ton, Wiberg's quarry; Oscar Huber, Spokane, 68½ cts. pre ton, quarry at Fisher's Landing; N. J. Blagen, Portland, 63½ cts. per ton, stone from Fisher's Landing; Oak Grove Rock & Contract Co., 48½ cts. per ton, stone from Minthorn Spring; John E. Howard, Killgaver, Ore., 69 cts. per ton, stone from Fisher's Landing or Milwaukee; J. E. Smith, Portland, 54½ cts. per ton, stone from Fisher's Landing; Pacific Paving Co., 51½ cts. per ton, Bunker Hill quarry, Cowlitz county, Wash., McCubbin & Jacobsen, Portland, 51⅞ cts. per ton; Fisher's Landing.

WATER GATES.—Salem, Mass.—The water board received the following bids last week for furnishing two 36-in. gates for the new water supply at Longham Meadow: Ludlow Valve Mfg. Co., $351.95 each; Chapman Valve Mfg. Co., $321 each; Rensselaer Valve Mfg. Co., $500 for two gates (awarded contract).

ASPHALT AND ASPHALT BLOCK PAVING.—Erie, Pa.—The following bids were received by Geo. Platt, Cy. Engr., for 3,600 sq. yds. of paving in 11th St., with asphalt blocks, including 2,100 lin. ft. of curbing, (1) being for blocks on 5 ins. gravel and 2 ins. sand, and (2) on 4 ins. concrete and 2 ins. sand:

	1.	2.	Catch basins.	Pipe, 9-in.	Pipe, 6-in.
Henry Mayer, Erie.	$2.25	$2.39	$35.00	$0.60	$0.50
V. D. Eichenlaub, Erie.	2.43	2.53	35.00	.35	.30
E. M. Ayers, Zanesville, O.	2.47	2.62	50.00	1.00	.90
J. McCormick & Son, Erie.	2.48	2.68	25.00	.30	.20
Dominick Flannigan, Erie.	2.62½	2.70	35.00	.50	.45

Henry Mayer bid $2.75 per sq. yd. for paving with 2 ins. sheet asphalt, on 1-in. binder and 4 ins. concrete, and $2.18 for 2 ins. asphalt on 4 ins. concrete, and the Barber Asphalt Paving Co., Buffalo, N. Y., bid $3 and $2.65, respectively, with catch basins at $40 and 9 and 6-in. pipe at 75 cts. and 70 cts. The street committee has recommended to the council that the contract be awarded to Henry Mayer for asphalt blocks in 5 ins. gravel and 2 ins. sand.

STONE BRIDGE.—Sandusky, O.—The following bids were received Sept. 18 for constructing a stone arch bridge over Mill Creek, (1) being the price per cubic foot for 18,255 cu. ft. of sandstone masonry, (2) for 1,918 cu. ft. of limestone retaining wall, and (3) the price per cubic yard for 460 cu. yds. of rock excavation:

	1.	2.	3.
Frederick Schumer, Norwalk, O.	$0.26	$0.09	$1.33
Truit & Briton, Milan, O.	.27¾	.07	.75
Stein Bros., Milan, O.	.27¾	.07	.75
Wm. Eberle, Sandusky, O.	.27½	.11½	.45
Henry Py, Sandusky, O.	.32½	.12½	.47
Brode & Kissner, Oak Harbor, O.	.28	.12	1.25
W. B. Wilson, Buffalo, N. Y.	.29	.18	1.00
G. W. Doerzbach, Sandusky, O.	.33½	.06⅞	.75
Schuster & Kunkl, Port Clinton, O.	.39¾	.06⅞	1.15

DREDGING.—Duluth, Minn.—Maj. C. B. Sears, U. S. Engr. Office, writes us that the following bids were received Sept. 20, (1) being the price per cu. yd. for dredging in Superior Harbor, Wis., (2) for dredging the channels in Duluth Harbor, (3) for dredging the St. Louis River above Grasse Point, the dumping to be in Lake Superior, (4) same, dumping to be above Grasse Point, (5) dredging 75,000 cu. yds. of sand and soft material at the Portage Lake ship canals, (6) 80,000 cu. yds. hardpan and stiff clay, same place, (7) 160,000 cu. yds. at Edgerton's Point and in Lily Pond, (8) price per hour for use of dredging plant:

	1.	2.	3.	4.	5.	6.	7.	8.
James Pryor, Houghton, Mich	$0.165	$0.16	$0.27	$0.20	$0.17	$0.235	$0.155	$10.00
Charles S. Barker, West Superior, Wis.	.125	.14	.24	.17	.175	.25	.155	12.00
Williams, Daugherty & Upham, Duluth	.139	.134	.20	.15	.15	.20	.135	10.00
Dunbar & Sullivan, Sault Ste. Marie, Mich	...	...	...	...	.12	.30	.12	8.00

Chicago, Ill.—Capt. W. L. Marshall, U. S. Engr. Office, received the following bids Sept. 25 for dredging in Calumet River, (1) being the price per cubic yard for work above the forks, and (2) for work below the forks:

	1.	2.
Wis. Dredge & Dock Co., Manitowoc, Wis.	$0.149	$0.22
McMahon & Montgomery Co., Chicago	.129	...
Chicago Dredging & Dock Co., Chicago	.24	.185
S. O. Dixon, Racine, Wis.	...	.195
W. A. McGillis & Co., Chicago,	...	.165

DITCHES.—St. Paul, Minn.—The Red River Valley Drainage Commission awarded the following contracts Sept. 24 for ditches: Muskinka, in Travers county, to Coughren & Riley, at 8½ cts. per cu. yd.; Rabbitt ditch, in Grant county, to Plaisted & Bushnell, at 6.49 cts. per cu. yd.; Otter Tail ditch, in Wilkin county, to Johnson & Plaisted, at 7 15-16 cts. per cu. yd.; Kennedy, in Norman county, to T. C. Rhinehart, at 7¾ cts. per cu. yd.

IRON WORK.—Charleston, W. Va.—The contract for iron work for movable dams Nos. 9, 10 and 11, Great Kanawha River, has been awarded by Col. W. P. Craighill, U. S. Engr. Office, to the Youngstown Bridge Co., the bids being as follows:

Bidder.	Wrought iron, 586,000 lbs. cts.	Drift bolts, 40,000 lbs. cts.	Cast Iron, 337,000 lbs. cts.	Total.
Youngstown Bridge Co., Youngstown, O.	4.09	2.10	2.10	$32,073
Novelty Iron Co., Canton	4¾	1.83	1.93	35,236
Lane Bros. Bridge & Construction Co., Newark, O.	4.70	1.95	2.09	35,541
Ryan-McDonald Mfg. Co., Baltimore, Md.	4.57	2.08	2.33	35,651
W. H. March, Phila., Pa.	4.47	1.84	2.73	36,296
Van Dorn Iron Works Co., Cleveland, O.	4.9	1.9	2.9	39,418
Russell Wheel & Foundry Co., Detroit, Mich.	5.59	1.79	1.90	40,037
J. Rees & Sons, Pittsburg	5.1	2.2	2.8	40,400
Brown-Ketcham Iron Wks., Indianapolis, Ind.	5.46	2.45	2.48	41,554
Snead & Co. Iron Wks., Louisville, Ky.	5.64	2.71	2.23	41,893
Hoefinghoff & Lane Foundry Co., Cincinnati, O.	6¼	2½	2¼	45,351
J. E. Greenwald Co., Cincinnati, O.	6.	2.36	3.	46,426
F. J. Meyers Mfg. Co., Hmltn	6.1	5.9	2½	46,500
Phoenix Bridge Co., Philadelphia, Pa.	5¾	4.	3.8	48,461

RESERVOIR EXCAVATION.—Washington, D. C.—The following bids were received Sept. 20 for making excavations and constructing embankment for the proposed new reservoir at Fort Reno: Chas. H. Eslin, 15 cts. per cu. yd.; W. H. H. Allen, 15⅝ cts.; R. Oates, 16¾ cts.; M. N. Myers, 17½ cts.; Lyons Bros., 17⅞ cts.; Martin McNamara, 19⅛ cts.; Hussey & Brown, 20½ cts.; J. Paul Smith, 21¼ cts.; Geo. K. Killeen, 24 cts., and Andrew Gleason, 29 cts.

BRICK PAVING.—Leavenworth, Kan.—The council received bids Sept. 19 for about $8,000 worth of brick paving in Delaware St. Adam Geiger, Leavenworth, bid 84 cts. per sq. yd. for St. Joseph brick and 47½ cts. per lin. ft. for stone curbing; T. K. Smith, Leavenworth, bid 87 cts. per sq. yd. for Leavenworth brick and 40 cts. per lin. ft. for stone curbing and $200 for two-thirds of the old blocks; F. G. Trestrail, Kansas City, submitted a bid in excess of these.

ASPHALT PAVING.—Binghamton, N. Y.—Lewis Seymour, Cy. Clk., writes us that the city has awarded the following contracts this year for paving with asphalt, all to the Warren-Scharf Asphalt Paving Co.: Court St. (short strip), $2.75 per sq. yd.; Chenango St., $2.75; State St., $2.75; Henry St. (no street-car tracks), $2.73.

SEWERS AND CASTINGS.—Erie, Pa.—The contract for constructing a 12-in. tile sewer in Chestnut St. has been awarded to Jones & Sullivan, at 55 cts. per lin. ft. There were seven bids. The contract for iron castings, etc., for the next year was awarded to the South Erie Iron Wks., at 1.49 cts. per lb. Last year the city paid 2½ cts.

SEWERS.—Scottdale, Pa.—E. L. Rutherford, Borough Secy., informs us that Ulrick, Nissley & Williams, Springfield, O., were the lowest bidders for constructing the sewers recently advertised in Engineering News, the detailed bids being as follows:

BIDS RECEIVED SEPT. 17, 1894, FOR CONSTRUCTING SEWERS AT SCOTTDALE, PA.

			Ward & Stuckey, Harrisburg, Pa.	John Sweeney, Pittsburg, Pa.	Standard Const'n Co., Pittsburg, Pa.	W. J. Berry, Lillies Baltom, Belmont Co., O.	B. McPoland, Pittsburg, Pa.	H. Anson, Alliance, Ohio.	Ulrick, Nissley & Williams, Springfield, O.	R. T. Hallam & Sons, Washington, Pa.	P. Morgan, Kingston, N. Y.	J. J. Stringer, Steubenville, O.	J. I. Dick, Scottdale, Pa.	Caleb & Coutare, Bridgeport, O.	John Hermann, Latrobe, Pa.	F. McGonegly, Mt. Pleasant, Pa.	Bowman Bros., McKeesport, Pa.	P. J. Flynn, Allegheny, Pa.	Headly & Christie, Newark, N. J.	P. O'Conner, Toronto, O.
Poplar alley	12-in.	2,000 ft.	$0.38	$0.59	$0.50	$0.55	$0.50	$0.60	$0.40	$0.55	$1.00	$0.95	$0.90	$1.00	$0.62	$0.60	$0.64	$0.63	$0.65	$0.55
O'Niel "	15 "	680 "	.60	.70	.75	.63	.90	.60	.60	.75	1.10	1.20	1.42	1.50	.66	.70	.72	.83	.82	.70
O'Niel "	12 "	1,350 "	.58	.52	.55	.55	.50	.60	.40	.55	.95	.95	1.16	.85	.60	.60	.64	.63	.75	.50
Meadow "	12 "	580 "	.58	.50	.65	.55	.50	.50	.40	.55	.95	.95	1.26	1.20	.62	1.05	.64	.63	.70	.55
Lentz "	12 "	410 "	.58	.52	.50	.55	.50	.50	.40	.55	.95	.95	.96	.54	.60	1.05	.64	.63	.65	.55
Oak "	12 "	1,618 "	.58	.54	.65	.55	.50	.60	.40	.55	.95	.95	.96	1.10	.76	1.05	.64	.63	1.00	.55
Grove street	12 "	779 "	.58	.53	.70	.55	.55	.70	.40	.55	.95	.95	.88	1.40	.66	1.05	.64	.63	.80	.55
Naylor alley	12 "	295 "	.58	.52	.60	.55	.60	.40	.40	.55	.95	.95	.77	.61	.60	1.00	.64	.63	.80	.55
McCune avenue	12 "	200 "	.58	.54	.60	.55	.60	.40	.40	.55	.95	.95	.77	.61	.60	1.00	.64	.63	.80	.55
Taylor alley	12 "	680 "	.58	.54	.65	.55	.70	.60	.40	.55	.95	.95	.88	1.30	.62	1.00	.64	.63	.90	.55
South Broadway	18 "	300 "	1.85	1.25	1.15	.71	1.12	1.20	.75	.85	1.50	3.00	1.63	1.50	1.15	1.50	.84	1.25	1.00	1.15
" "	12 "	490 "	.58	.57	.65	.55	1.00	1.15	.40	.55	.95	.95	1.29	1.40	1.10	1.30	.64	.97	.90	.70
" "	10 "	197 "	.58	.45	.60	.45	.50	.85	.35	.45	.90	.90	1.21	1.00	.95	1.35	.62	.97	.85	.40
Graft alley	12 "	500 "	.58	.54	.50	.55	.69	.50	.40	.55	.95	.95	1.16	1.50	.66	.90	.64	.97	1.00	.55
Outlet	20 "	686 "	2.07	1.40	1.35	1.00	1.30	1.75	1.70	1.25	2.00	4.00	1.71	2.00	1.40	1.50	1.54	1.52	1.70	1.40
Broadway	20 "	677 "	2.48	1.35	1.25	.81	1.20	1.40	1.50	1.00	1.70	3.50	1.90	1.80	1.25	1.45	1.24	1.52	1.00	1.20
"	15 "	683 "	.60	.70	.85	.63	1.00	1.20	.60	.75	1.25	1.20	1.50	.90	1.20	1.30	.72	1.19	.85	1.00
Grove alley	12 "	800 "	.58	.60	.50	.55	.75	.50	.40	.35	.95	.95	.64	1.80	.78	1.20	.64	.99	.75	.55
Short street	15 "	520 "	.60	.80	.90	.63	.59	1.20	.60	.75	1.50	1.20	1.42	1.00	1.20	1.30	.72	1.19	1.10	1.00
Private property	15 "	340 "	.60	.75	.85	.63	.60	1.30	.60	.75	1.10	1.20	1.07	1.70	1.20	1.30	.76	1.25	1.10	.90
Chestnut street	15 "	130 "	.60	.75	.90	.63	.50	1.25	.60	.75	1.10	1.20	1.07	1.05	1.20	1.30	.72	1.23	1.25	1.00
Brook street	15 "	385 "	.60	.70	.95	.63	1.00	1.20	.60	.75	1.10	1.20	1.42	.90	.95	1.30	.72	1.23	1.10	1.05
Spring alley	15 "	183 "	.60	.70	.85	.63	.60	1.20	.60	.75	1.10	1.20	1.27	.72	.80	1.30	.72	1.23	1.10	.95
" "	12 "	180 "	.58	.60	.60	.55	.60	1.00	.40	.55	.95	.95	1.05	.67	.75	1.30	.64	1.23	1.00	.55
Maple "	15 "	430 "	.60	.70	.85	.63	.50	1.15	.60	.75	1.10	1.20	1.27	.71	.70	1.20	.72	1.23	1.10	.95
Catch basins, 2, each			35.00	40.00	45.00	5.00	35.00	40.00	25.00	30.00	75.00	22.00	57.00	24.25	30.00	35.00	45.00	22.00	....	40.00
Manholes, 16, each			18.00	20.00	20.00	20.00	16.00	30.00	25.00	20.00	35.00	20.00	35.00	22.25	22.00	30.00	30.00	18.00	....	19.00
Lampholes, 15, each			5.00	3.00	5.00	2.00	3.00	2.50	10.00	4.00	5.00	2.00	4.00	1.75	3.00	5.00	5.00	5.00	....	4.00

Faribault, Minn.—The contract for a 15-in. pipe sewer in Third St. has been awarded to O'Neil & Smith, at 50 cts. per lin. ft.; manholes, at $40 each; lampholes, at $8 each.

Utica, N. Y.—The contract for a 9-in. vitrified pipe sewer in Lock St. has been awarded to Thomas Joyce, at 43½ cts. per lin. ft.; branches, 40 cts. each, extra; 6-in. house connections, 30 cts. per lin. ft.; manholes, $22 each; lumber in foundation, $13 per M. ft.

Jersey City, N. J.—The following bids were received last month for constructing a main sewer in Pine St.:

Bids Received at Jersey City, N. J., for a Main Sewer in Pine St.

Items.	Burke & Jones.	P. L. Rehill.	Thos. Wood.	Ed. O'Neill.	P. T. Plukett.	Thos. Cavanaugh.	H. Cunningham.	P. J. Mullery	F. C. Meehan.	Andrew Shaw.
30-in. brick sewer on piles, per lin. ft.	$2.80	$2.25	$2.65	$2.75	$2.80	$3.25	$3.25	$3.40	$4.00	$3.10
30-in. iron pipe on piles, per lin. ft.	6.00	4.00	5.00	6.00	5.70	6.00	7.00	6.40	9.00	9.50
Piles, per lin. ft.	.20	.32	.35	.25	.17	.15	.15	.28	.01	.32
Spruce capping, per M. ft. B. M.	18.00	32.00	35.00	30.00	25.00	30.00	20.00	20.00	60.00	25.00
Sheathing, 8,000 ft., per M. ft. B. M.	18.00	22.00	10.00	10.00	20.00	.01	20.00	25.00	20.00	21.00
Spruce flooring, per M. ft. B. M.	18.00	32.00	35.00	30.00	25.00	30.00	20.00	25.00	20.00	25.00
Receiving basins, each	75.00	125.00	100.00	75.00	75.00	100.00	90.00	100.00	78.00	95.00
Brick masonry, per cu. yd.	5.00	9.00	8.00	6.00	7.00	7.00	9.00	6.00	3.50	8.95
Earth filling, per cu. yd	.01	.30	.30	.30	.35	.05	.25	.30	.25	.20
Iron spikes, per lb.	.02	.08	.10	.04	.07	.10	.20	.10	.25	.05

Washington, D. C.—We are informed that the bids for sections A, B, E, H and I of the work recently advertised, have been rejected, and that contracts for the remaining sections were awarded as follows: Buckley & Larguey, Washington: Section C.—2.75 × 4.125-ft concrete sewer, including all appurtenances except manholes, 420 lin. ft., at $5.73 per lin. ft.; 2.5 × 3.75-ft. concrete, 570 ft., $4.10; 2.25 × 3.375-ft. concrete, 350 ft., $4.10; manholes, $23 each. B. J. Coyle, Washington: Section D—3.25 × 4.875-ft. concrete, 1,000 ft., $5.70; 3 × 4.5-ft. concrete, 440 ft., $5.40; manholes, $30. E. G. Gummel, Eckington, D. C.: Section F.—2 × 3-ft. brick, 370 ft., $4.12; manholes, $27; section G, —2.5 × 3.75-ft. brick, 275 ft., $5.61; 2 × 3-ft. brick, 210 ft., $4.20; manholes, $25; section K.—2.25 × 3.375-ft. brick, 780 ft., $4.52; manholes, $29; section L.—21-in. sewer, 350 ft., $1.50; 24-in., 840 ft., $1.81; 18-in., 800 ft., $1.37; manholes, $29; section M.—24-in. sewer, 170 ft. $1.31; 21-in. 595 ft., $1.43; 15-in., 650 ft., $1.22; manholes, $19, $21 and $23 each; section O.—24-in. sewer, 500 ft., $1.87; manholes, $27; section P.—21-in. sewer, 980 ft., $1.60; 18-in., 60 ft., $1.45; manholes, $25. Cotton & Bolden, Washington: Section N.—24-in. sewer, 630 ft., $1.89⅞; manholes, $22.98.

BASALT BLOCK AND BITUMINOUS ROCK PAVING, ETC.—San Francisco, Cal.—Contracts have been awarded as follows: To C. S. Harney, paving with basalt blocks, 21 cts. per sq. ft., granite curb, $1 per lin. ft.; City Street Improvement Co., paving with bituminous rock, 20¾ cts. per sq. ft., granite curb, 10 cts.; Pacific Paving Co., paving with bituminous rock, 21 and 21½ cts. per sq. ft., granite curb, 75 cts.; R. H. Wood, bituminous rock sidewalks, 7½ cts. per sq. ft., redwood curb, 12 cts., plank sidewalks, 39 cts.; S. L. Lent, grading, 13 cts. per cu. yd.

REMOVING SHOAL.—Detroit, Mich.—The following bids were received at the U. S. Engineer Office Sept. 22 for removing a shoal in section S of the ship channel between Chicago, Duluth and Buffalo, (1) being the price per cubic yard for 5,000 cu. yds. of bed rock above 21-ft. grade, bank measure; (2) for 267 cu. yds. other than bed rock above 21-ft. grade, scow measure, and (3) the total:

	1.	2.	3.
L. P. & J. A. Smith Co., Cleveland, O.	$2.24	$.95	$11,454
Conrad Starke, Milwaukee, Wis.	3.00	1.00	15,267
Carkin, Stickney & Cram, Saginaw, Mich.	3.16	3.16	16,644
Buffalo Dredging Co., Buffalo, N. Y.	3.60	1.00	18,267
P. Sanford Ross, Jersey City, N. J.	5.60	1.00	28,267
Hingston & Woods, Buffalo, N. Y.	5.90	.50	29,633
Dunbar & Sullivan, Buffalo, N. Y.	5.95	.40	29,857
W. Johnston & Enoch Townsend, Somers Point, N. J.	9.98	9.00	52,303

DAMS AND SHORE PROTECTIONS.—Rock Island, Ill.—Bids were opened at the U. S. Engineer Office Sept. 22 for seven contracts for constructing dams and shore protections on the Mississippi River and the following bids recommended for acceptance: Albert Kirchner, Fountain City, Wis., work between Genoa and Prairie du Chien, Wis., 20,000 cu. yds. of rock in place at $1 per cu. yd., and 25,000 cu. yds. of brush in place at 39 cts. per cu. yd.; between Glenhaven, Wis., and Dubuque, Ia., 20,000 cu. yds. of rock at $1, and 25,000 cu. yds. of brush at 39 cts.; Jacob Richtman, Fountain City, Wis., work between Dubuque and Clinton, Ia., 20,000 cu. yds. of rock at $1.30, and 25,000 cu. yds. of brush at 20 cts.; between Keokuk, Ia., and Quincy, Ill., 20,000 cu. yds. of rock at $1.30, and 25,000 cu. yds. of brush at 20 cts.; between Clarksville, Mo., and Hamburg, Ill., 20,000 cu. yds. of rock at $1.20, and 25,000 cu. yds. of brush at 10 cts.; between Hamburg, Ill., and Cap au Gris, Mo., 25,000 cu. yds. of rock at $1.20, and 25,000 cu. yds. of brush at 10 cts.; between Cap au Gris, Mo., and mouth of Illinois River, 25,000 cu. yds. of rock at $1.10, and 25,000 cu. yds. of brush, at 10 cts. The other bidders were: Christie & Lowe, Chicago, Ill.; H. S. Brown, Quincy, Ill.; L. W. Lewis, Emporia, Kan.; Andrew J. Whitney, Rock Island, Ill.; Sidney J. Truax, Hastings, Minn.; Patterson Bros., Keokuk, Ia.; James Short, St. Charles, Mo.; Kelly & Monroe, Portsmouth, O.; R. L. Van Sant, St. Louis, Mo.; Bigelow & Teasdale, La Crosse, Wis.; William P. Truax, Hastings, Minn.

LEVEE WORK.—New Orleans, La.—The following lowest bids were received at the U. S. Engineer Office last week: Pontchartrain district.—Jacobs, 28,000 cu. yds., J. A. Carson, 10.99 cts. per cu. yd.; Frellsen, 31,000 cu. yds., R. M. Quigley & Co., 13 cts.; Belmont, 64,000 cu. yds., R. M. Quigley & Co. and P. J. Millet, 14 cts. Lafourche district.—Saulsberg, 25,000

cu. yds., John Trenan, 9 cts.; Ferchaud, 16,000 cu. yds., John Trenan, 10.68 cts. Barataria district.—Getzinger, 21,000 cu. yds., I. R. Babbitt, 13⅞ cts.; Upper Concord, 14,000 cu. yds., J. A. Carson, 12 cts.; Lower Concord, 23,000 cu. yds., J. A. Carson, 12 cts. Lake Borgne district.—Upper Caernarvon, 23,000 cu. yds., R. McNamara, 14 cts.

PUMPING ENGINE AND BOILERS.—Springfield, O.—We are informed that the contracts which were awarded some time ago were at the following prices: 5,000,000-gallon vertical triple expansion pumping engine, E. P. Allis Co., at $31,000; 350-HP. boilers, Babcock & Wilcox, at $7,779; building, O. N. Bartholomew, Springfield, at $18,213; all advertised in Engineering News.

METAL MARKET PRICES.

LEAD.—New York: 3.12 to 3.15 cts. Chicago: 3 cts. St. Louis: 2.9 to 3 cts.

NAILS.—Pittsburg: $1 for wire, and 85 cts. for cut at mill, in carload lots.

BARBED WIRE.—Pittsburg: galvanized, $2 to $2.05; plain, $1.25 for carload lots at mill.

FOUNDRY AND PIG IRON.—New York: $10.50 to $13. Pittsburg: $10.75 to $12. Chicago: $9.50 to $10.50.

TRACK MATERIAL.—New York: angle bars, 1.25 to 1.4 cts.; spikes, 1.55 to 1.7 cts.; track bolts, 2 to 2.1 cts. with square, and 2.15 to 2.3 cts. with hexagon nuts. Chicago: angle bars, 1.25 to 1.35 cts.; spikes, 1.65 to 1.75 cts.; track bolts, 2.1 to 2.2 cts., with hexagon nuts.

RAILS.—New York: $24 at eastern mills and at tidewater; old rails, $11.50 to $12 for iron and $9 to $9.50 for steel; steel rails, fit for relaying, $16 to $19; light rails, $22 to $24; girder rails, $24. Pittsburg: $24 for standard sections. Chicago: $25 to $27; old rails, $11 to $11.25 for iron and $7.50 to $11 for steel.

STRUCTURAL MATERIAL.—New York: beams, 1.35 to 1.5 cts.; channels, 1.4 to 1.5 cts.; angles, 1.3 to 1.35 cts.; tees, 1.5 to 1.6 cts.; universal mill plates, 1.25 to 1.35 cts.; steel plates, 1.3 to 1.4 cts. for tank, 1.4 to 1.5 cts. for shell, 1.6 to 1.65 cts. for flange, 1.75 to 2 cts. for ordinary firebox, 2 to 2.25 cts. for locomotive firebox. Pittsburg: beams, 1.25 to 1.35 cts.; channels, 1.25 to 1.35 cts.; angles, 1.15 to 1.2 cts.; tees, 1.4 cts.; universal mill plates, 1.15 to 1.2 cts.; steel plates, 1.2 to 1.25 cts. for tank, 1.3 to 1.4 cts. for shell, 1.35 to 1.45 cts. for flange, 2.5 to 3.75 for ordinary firebox, and 3.35 to 3.5 cts. for locomotive firebox. Chicago: beams, 1.45 to 1.5 cts.; channels, 1.45 to 1.5 cts.; angles, 1.4 to 1.45 cts.; tees, 1.65 cts.; universal plates, 1.4 to 1.45 cts.; steel plates, 1.4 to 1.5 cts. for tank, 1.65 to 2.1 cts. for flange, 1.65 to 5 cts. for firebox.

INDUSTRIAL NOTES.

THE STIRLING BOILER CO., of Chicago, has a contract from the West Chicago St. Ry. Co. for water-tube boilers aggregating 8,000 HP.

THE INDIANA STEEL CASTING CO. has closed a contract to locate the plant at Anderson, Ind. The company has an authorized capital stock of $200,000. Man., William Chambers.

THE AMERICAN ROAD MACHINE CO., Kennett Square, Pa., reports that during the current year considerable new machinery has been put in, and that in addition to these additions it will put in two new 80-HP. boilers this fall. The building of a new office building is also contemplated, the structure to be about 40 × 40 ft., and two stories high. Business is reported good.

THE NYE STEAM PUMP & MACHINERY CO., of Chicago, Ill., recently incorporated, has purchased the patents and patterns for the Geo. F. Nye improved steam vacuum pump, also those of the Columbian Steam Pump Co. The new company is located at 7 and 9 South Jefferson St. Pres., Frank E. Nye; Secy. and Treas., George B. Nye.

MARIS & BEEKLEY, of Philadelphia, Pa., have orders for a 12-ton traveling crane, 43 ft. long, and runways 111 ft. long, for the Tokio Electric Light Co., Japan, and a 10-ton traveling crane, 30 ft. long, for the Murray Iron Works Co., Burlington, Ia. Both of these cranes are fitted with the firm's new two-speed automatic friction brake hoist.

THE YOUNGSTOWN BRIDGE CO., of Youngstown, O., has been awarded the contract for the metal work for dams Nos. 9, 10 and 11 on the Great Kanawha River, as stated under our Contract Prices. The company has also recently been awarded the contract for two spans of riveted lattice for the Valley Ry., and a one-span three-truss bridge on Columbia Ave. in Baltimore, Md. It reports that it has also under way quite a large amount of structural and railway work.

THE MICHIGAN PIPE CO., of Bay City, Mich., has lately added to its extensive works a complete creosoting plant for the purpose of creosoting timber, lumber, piles, cross-ties, etc., and especially for creosoting underground electrical conduits of every description and completing them ready for laying in the trench. It can obtain in the neighboring market the best class of timber for this purpose, and by the addition of the creosoting plant is enabled to furnish a very high class conduit.

THE NATIONAL SWITCH & SIGNAL CO., of Easton, Pa., has closed a contract through Mr. H. J. Payne, Chief Engineer of the Duluth, South Shore & Atlantic Ry., for interlocking the crossing of the Chicago, St. Paul, Minneapolis & Omaha and the Lake Superior Terminal & Transfer railways at West Superior, Wis. The double anti-friction pipe carrier, lately introduced by this company, is meeting with considerable success. This carrier was described in our issue of Sept. 20.

THE BROOKS LOCOMOTIVE WORKS, at Dunkirk, N. Y., is putting in an extensive electrical plant for running 75 arc lights and 300 incandescents, and also electrical motors and generators for operating three overhead traveling cranes, including the 80-ft. span crane in the boiler shop. Electric motors will also be used for working the transfer table, the fans in the foundry and also for certain tools in the boiler shop to supersede steam. The Western Electric Co., of Chicago, is doing the work.

NEW COMPANIES.—Portland Cement Paving & Construction Co., Brooklyn, N. Y.; $3,000; Wolfgang Z. Triest, of New York; H. J. Kreuzweiser, Brooklyn.——Triple-Cylinder Engine Co. Minneapolis, Minn.; $1,000,000; Jay W. Powers, W. D. Reynolds and Jas. S. Ingalls.——Greensboro Steel & Iron Co., Greensboro, N. C.; Pres., Julian C. Carr, Durham, N. C.——International Contract Co., Chicago, Ill.; $300,000; John B. Mesny, C. H. Tallmadge and Rollin W. Miller.——Atlantis Construction Co., Chicago, Ill.; $4,000,000; Charles M. Coon, John F. Anderson and W. W. Fleming.——Columbian Equipment Co., New York, N. Y.; $1,000,000, all subscribed: Wayland Trask, Brooklyn, N. Y.; Samuel McCord, Milwaukee, Wis., and A. N. Rankin, New York.——American Electric Smelting Co., Wheeling, W. Va.; $1,000,000, commencing with $250; J. A. Campbell, Chas. Menkeweller and T. H. B. Haase.——New York Gas Improvement Co., New York, N. Y.; $500,000; Geo. Place, W. M. Moore and Henry A. Jones.——Lake Shore Iron & Steel Co., Chicago, Ill.; $20,000; Hugh J. O'Neil, H. J. Benjamin and S. F. Knox.——Tramway Power Storage Co., New York, N. Y.; $1,500,000, commencing with $250; superheated water for power purposes; H. Walter Webb, Edgar Van Etten and A. G. Leonard.——Electro-Magnetic Traction Co., Washington, D. C.; $5,000,000, commencing with $250; M. Wheeless and E. W. Creecy.——Gordon Street Sweeping Co., New York, N. Y.; $200,000, commencing with $1,000; H. H. Finley, John Z. Kaus and Eugene Harris.——Norristown Range Boiler Works, Philadelphia, Pa.; $100,000, commencing with $250; E. H. Diffenbach, D. B. Yerger and G. B. Gilbert.

MUNICIPAL BOND MARKET.

New York, Oct. 2, 1894.

The prominent feature of the financial situation both at present and for some weeks back is and has been the continued absorption of municipal bond issues for the account not only of the investing public, but also for savings banks and other institutions. The continued large supply of money, coupled with the difficulty experienced by institutions and individuals in finding sufficient employment for spare capital, even at the low rates of interest now prevailing, makes possible further liberal purchases of all good investment issues. And, when to this continued ease in money is added the reduction in supply of all good issues, it is not to be wondered at that prices should be well maintained. Offerings are very moderate and totally inadequate to the demand. New issues are still rare, the amount of new municipal bond loans offering in September being much smaller than in August even, and buyers must consequently rely on the old supply, which, by reason of the absorbing process, continually going on during the prolonged ease in the money market, has become reduced to very small proportions.

It would seem that municipalities ought to be eager to take advantage of the good demand for bonds and so obtain money on very easy terms, for much needed public improvements. And it is likely that once this fact is appreciated by the smaller inland cities and towns, they will make haste to secure funds in this fashion wherewith to build sewers, bridges, waterworks, etc., that will prove a gratifying source of profit to the engineering trade. Already some of them have drafted resolutions for issuing bonds for these purposes which will soon be voted by their citizens at special elections, and their result will almost uniformly redound to the benefit of engineers and contractors. Thus Medford, Mass., has issued $50,000 4 per cent. water fund bonds, and $40,000 4 per cent. sewerage bonds, the former bringing 104.276 and the latter 103.63. Newton, Mass., also issued $60,000 4 per cent. sewer bonds. These are examples of how quick the more prosperous small municipalities have been to take advantage of their opportunity.

The most important sale noted this week has been the disposal by Salt Lake City, Utah, of $100,000 5-per cent. 20-year bonds to E. H. Gray & Co., of Boston. The bonds were disposed of at private sale, but did not bring more than 102. This low price does not compare with the price of 104.276 noted above as paid for Medford, Mass., 4s. Bond dealers are also taking a deal of interest in the coming sale of Brooklyn bonds, Comptroller Corwin announcing that he will receive proposals until the 15th inst. for $500,000 4-per cent. registered tax certificates maturing at an early date, and for $70,000 more payable July 1, 1896.

As showing the extending interest taken in municipal bonds, it may be noted that Messrs. Harvey Fisk & Sons, whose operations have been chiefly confined to transactions in Government bonds and first-class railway mortgages, have opened a new branch house in Boston, so as to take advantage of the active New England municipal bond market. Their first transaction was the purchase of the $50,000 Holyoke, Mass., 10-year 4s at 103.27; they offer them now to investors in lots to suit at 104¼ and interest. This is cheap compared to New York city 2½s, which command 92½ and interest.

As furnishing to contracting engineers and other interested individuals some indication as to the credit enjoyed by various municipalities and townships, the following table of current offerings is appended:

MUNICIPAL BONDS.

	Price.
City of Brainerd, Minn., School District 6s	107¾
County of Brazoria, Tex., Court House, 6s	103¼
Spokane County, Wash., School District 6s	104⅜
St. James, Minn., Water Works 6s	107½
Balar County, Tex., Court House 6s	107⅜
Park County, Mont., Funding 6s	109¼
City of Tracy, Minn., Funding 6s	104⅜
City of Pueblo, Col., Gen. Fund, 6s	104⅜
County of Flathead, Mont., 6s	107½
City of Bartow, Fla., 6s	102
City of Pana, Ill., Water 6s	105½
City of Chicago, Drainage 5s, 1895	100¾
" " " 5s, 1914	107⅜
Otter Tail County, Minn., Ref. 5s	105
City of Omaha, Neb., City Park 5s	111
Marseilles, Ill., School 5s	102½
City of Galveston, Tex., Water Works 5s	101½
City of Portland, Ore., Water 5s	112½
City of Parkersburg, W. Va., 5s	102
City of Cheboygan Mich., Water 5s	103¼
City of Salt Lake, Utah, Gen. Fund, 5s	103¼
City of Tacoma, Wash., Water 5s	102
Asbury Park, N. J., Water 5s	108
City of East Liverpool, O., School 5s	108
Methuen, Mass, Water 4s	1¾
City of Derby, Conn., Funding 4s	102½
City of Denver, Colo., Public Impvt. 4s	100
City of Brooklyn Water Loan, 4s	107⅜
" " " Sewer Loan, 4s	109½

RAILWAY STOCK MARKET.

New York, Oct. 2, 1894.

The absence from the stock market of the operating public continues to militate against any improvement in quotations for the shares of the railway companies. The stock market is heavily oversold; that is clearly evidenced by the fact that all active stocks are lending at a premium. By this time, also, the average of prices is fairly well down. Again, general conditions, as manifested by trade reports and increasing railway earnings, are rapidly approaching a normal state. Nevertheless, the majority of traders continue to entertain bearish views, and, so long as their operations are unhindered by outsiders, the majority will persist in making prices agree with their opinions, despite the fact that a bear market just now is entirely at variance with the generally favorable situation. As furnishing an indication of the inconsistency of the stock market, it may be mentioned that yesterday Louisville & Nashville shares, as compared with last Saturday's final quotation, closed ⅞ of a point lower, notwithstanding the fact that during the day the company reported net earnings for August $111,577 ahead of net earnings for the same month in 1893. Evidence furnished in this decided fashion that the advocates of lower prices form the only aggressive faction in Wall Street necessarily makes any hopes of immediate recovery based on current conditions rather ill-founded, as success only serves to make the bear party hold a still more advantageous position.

St. Paul, Burlington and Rock Island, typical granger stocks, are all lower. Missouri Pacific and Louisville & Nashville, heading different groups of Southern railways, share in the granger stocks' heaviness. Nor are the trunk line shares showing up much better. Even New York Central, whose directors agreeably surprised the financial world a week ago by declaring the regular 1¼% quarterly dividend, fails to betray life, in ordering the regular quarterly distribution among stockholders notwithstanding the fact that it has not been earned in the last two quarters, the Central's officers followed the example once set by Burlington in banking on prospects. There is, however, a good deal of justification for the act in this instance. In the first place not much risk is taken, as the commercial regions traversed by the Central will feel and are already appreciating the business revival to an extent that must bring large returns to the railways. Again the tonic influence of the action is of tremendous import. To many investors, at home and abroad, New York Central represents all that is conservative and safe in American railway administration, and any cutting of its dividend would by many nervous investors have been accepted as a sure indication of the thorough rottenness of all American railway companies. As guarding against the spread of any such ill-founded belief, the action of the Central's directors must be commended, despite the protests raised time and again in these columns against that practice of paying dividends out of surpluses or with borrowed money that has brought so many companies to grief.

The intimation herein made last week that the heroic sacrifices demanded of junior Reading security-holders are being fully borne out by the facts. The plan of reorganization outlined by the Olcott-Earle people will not be adopted. That much is accepted. So poor are its chances of success that all the selling prompted by the first publication of the plan has stopped, and the stock is even higher on attempts to buy back what was sold a week ago. Of the other "hospital" stocks, Atchison has shown most life, but at lower quotations. It is freely reported that Expert Little's report, soon to be published, will disclose a more rotten state of affairs than even the bears dared to anticipate.

RAILWAY STOCK MARKET.

Railway stocks.	Closing prices Oct. 2.
Alton & Terre Haute	31
Atchison, Topeka & Santa Fe	5¾
Baltimore & Ohio	75¾
Canada Southern	51
Chesapeake & Ohio	19
Chicago, Burlington & Quincy	72¼
Chicago & Northwestern	102¾
Chicago, Milwaukee & St. Paul	61½
Chicago, Rock Island & Pacific	60¼
Cleveland, Cincinnati, Chicago & St. Louis	39
Delaware, Lackawanna & Western	169½
Delaware & Hudson	131½
Hocking Valley	17¾
Illinois Central	93
Lake Shore & Michigan Southern	134½
Louisville & Nashville	55¼
Missouri Pacific	27
Missouri, Kansas & Texas	14
Mobile & Ohio	18¼
New Jersey Central	109¾
New York Central	100
New York & New England, 3d asst. pd.	29¾
New York, New Haven & Hartford	180
New York, Chicago & St. Louis, 1st pfd	65
New York, Lake Erie & Western	16¾
New York, Ontario & Western	16½
New York, Susquehanna & Western	16¾
Northern Pacific	4¾
Northern Pacific, pfd	18¾
Philadelphia & Reading	17¾
Richmond Terminal	18½
St. Paul & Omaha	35½
Southern Pacific	20¾
Texas Pacific	9
Union Pacific	12½
Wabash, pfd	14¾
Wheeling & Lake Erie	12¾

BOSTON RAILWAY STOCKS.

	Oct. 2.
Boston & Albany	206½
Boston & Maine	151
Fitchburg, pfd	76
Old Colony	177

PHILADELPHIA RAILWAY STOCKS.

	Oct. 2
Lehigh Valley	37½
Pennsylvania Railroad	51⅝

NOTICE TO CONTRACTORS.

Notice is hereby given that on Tuesday, October 9th, 1894, the County Commissioners of Marion County, Ohio, will sell at public outcry the construction of the Columbia Street County Ditch Improvement as an entirety which shall include the price for all material, labor, etc., used in the construction of said ditch according to the map, profile, plans, specifications and detail drawings on file in the Auditor's office of Marion County, Ohio. The contract will be awarded to the lowest responsible bidder to complete said improvement as above specified. Sale to take place on the line of said improvement.

The Columbia Street County Ditch Improvement is in general as follows:

9,356 lin. ft. of open ditch					
3,337	"	"	6½	ft.	brick arch.
2,203	"	"	5½	"	"
2,022	"	"	4½	"	"
2,888	"	"	3½	"	"
1,085	"	"	3	"	"
615	"	"	2	"	double strength sewer pipe.

No bids will be received unless the bidder has deposited with the Auditor of Marion County, Ohio, a certified check in the sum of $500.00, said check to be in evidence that the bids are made in good faith, and that the successful bidder will within five days after the award is made enter into a contract with and give bond to the County of Marion, State of Ohio. The successful bidder will be required to give bond in the sum of double the estimated value of the construction of said improvement; said bonds to be approved by the Commissioners of Marion County, Ohio.

B. J. Hill, the constructing engineer who made the apportionment of said improvement as directed, to superintend and conduct such sale.

The contract price will be paid in cash on estimates as provided for by law.

By order of the Commissioners of Marion county, Ohio.

Copy of specifications sent upon request.

U. K. GUTHERY,
County Auditor.
H. J. HILL,
Constructing Engineer.

MARION, O., Sept. 18, 1894. 39-2t

NOTICE TO CONTRACTORS.

The City of Vandalia, Ill., will receive bids till 12 o'clock noon, Oct. 18th, 1894, to furnish all material, tools and labor to construct a system of water-works according to plans and specifications which will be on file with the Mayor and Consulting Engineer on and after Oct. 8th, 1894.

Plant to include two ¾-million pumps, about 6 miles of pipe, and standpipe 80' × 15'.

Specifications may be obtained by addressing Mayor or Engineer.

GEO. STEINHAUER, Mayor.
HIRAM PHILLIPS,
Consulting Engineer.
40-2t 810 Olive street, St. Louis, Mo.

NOTICE TO CONTRACTORS.

Ten months' work on the Jaqui Canal, in Sonora, Mexico; the finest kind of material to handle; nearly 1,000,000 cubic meters to move; clearing and grubbing all done. To look at work, go to Guaymas, Mex., take boat from there to Medano. Notify French & Reed, at Cocorit, when you leave Guaymas; they will meet you with team at Medano. Communicate with FRENCH & REED, Cocorit, Mex. or 205 New High street, Los Angeles, Cal.

37-6t

UTICA PIPE FOUNDRY CO.

CAST IRON PIPE AND SPECIALS FOR WATER AND GAS.

Also flanged Pipe and Fittings, Hydrants, Gates, Pig Lead, etc. CHAS. MILLAR & SON, Selling Agents, Utica., N. Y. Manufacturers of Lead Pipe and Plumbers' Materials. Wholesale Eastern Agents Akron Vitrified Sewer Pipe.

FOR Best Results USE THE WARREN FILTER,

—MANUFACTURED BY—

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Chicago Office, 616 Chamber of Commerce

COLUMBUS SEWER PIPE CO. COLUMBUS, OHIO.

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MANUFACTURERS OF

Boiler Tubes, Wrought Iron Pipe and Fittings.

Electric Railway and Light Pipe Poles a Specialty.

Smoothness of motion, absolute safety and high speed are among the good qualities possessed by OTIS ELEVATORS. They are built by Otis Brothers & Co 38 Park Row, New York.

WHITE HALL FIRE CLAY WORKS MANUFACTURERS SEWER PIPE CULVERT PIPE ETC. ETC. WHITE HALL, ILL.

Works foot of LOOKOUT MOUNTAIN near Blowing Spring, Walker Co. Georgia

Most Complete in Every Detail.

LOOKOUT SEWER PIPE COMPANY

Capacity equal to any similar Plant in the South

STANDARD, VITRIFIED AND SALT GLAZED

Sewer and Railroad Culvert Pipe.

Especially recommended for smoothness of inside surface and conformity to true circular shap

For Price List, Discount, &c., Address

LOOKOUT SEWER PIPE CO., CHATTANOOGA, TENN.

STANDARD RESERVOIR AND TIDE GAUGE.

FOR USE ON RESERVOIRS, HARBORS, RIVERS, IRRIGATION CANALS, ETC.

The apparatus is small, compact, simple in adjustment, easily set up. It plots automatically a continuous curve for one month, one week, or one day, as may be required. Has been used for several years on some of the Principal Reservoirs and Harbors of the United States and Mexico. Prices greatly reduced.

For circulars and information write to

STANDARD GAUGE CO., No. 24 Haven Bldg., Buffalo, N. Y.

PROPOSALS FOR SEWER PIPES.

RECORDER'S OFFICE,
CITY OF JACKSONVILLE, Fla.,
September 14, 1894.

Sealed proposals will be received by the Board of Public Works of the city of Jacksonville, Fla., until Wednesday, October 10, 1894, at 3:30 o'clock, for supplying free on board at Jacksonville, Fla., not less than 200,000 feet of sewer pipe and "specials," not less than 60,000 feet to be delivered before November 1, 1894 and not less than 60,000 feet during each of the months of November and December, 1894; with a further delivery of such amounts as may be ordered one month in advance, not to exceed 60,000 feet each in January, February and March, 1895; the whole amount not to exceed 380,000 feet of all sizes.

The probable amount of each size required in the first 200,000 feet will be as follows:

6-inch, between 50,000 and 100,000 feet; 8-inch, between 75,000 and 125,000 feet; 10-inch, between 15,000 and 30,000 feet; 12-inch, between 10,000 and 25,000 feet; 15-inch, between 10,000 and 25,000 feet.

In the further deliveries the sizes will be within the limits of 6 and 16-inch, and the proportions will probably be similar to those above given.

The first 60,000 feet to be delivered November 1 is to be made up as follows:

6-inch, 15,000 feet; 8-inch, 35,000 feet; 10-inch, 5,000 feet; 12-inch, 5,000 feet; 15-inch, 5,000 feet.

All pipe and "specials" will be closely inspected as unloaded, and every piece not fully up to the highest standard of Ohio pipe and to all the requirements of specifications will be rejected. All pipe rejected must be taken possession of forthwith by the seller.

All pipe accepted will be paid for in cash within 30 days after acceptance.

All proposals to be marked "Bids for Sewer Pipe." The Board of Public Works reserves the right to reject any or all bids. For copies of specifications and other information address

38-3t WM. C. WEST, Recorder,
Secretary Board of Public Works.

WATER-WORKS, GIBSON, ILL.

Sealed proposals will be received by the Mayor and Fire and Water Committee of the City of Gibson, Ill., until three o'clock p. m., Oct. 18, 1894, for the furnishing of material and construction of water-works.

The works will consist in general of about four miles or more of cast iron mains, with valves, hydrants, valve boxes, and special castings, pumping station, reservoir, water tower, two boilers, two pumps and two or more 6 or 8 in. wells. Bids will be received for separate portions of the work. Plans and specifications can be seen after Oct. 10, 1894, at the office of the Mayor of the City of Gibson, Ill., and at the office of John A. Cole, consulting engineer, 1580 Old Colony Building, Chicago, Ill. Bonds satisfactory in amount and sureties will be required of those to whom contracts are awarded.

The right is reserved of rejecting any or all bids or of accepting those that in the judgment of the engineer and committee would be for the best interests of the City of Gibson. All bids to be sealed and indorsed on the envelope inclosing them, "Proposals for Water-Works," and addressed to T. D. Spalding, Mayor, Gibson City, Ill.

T. D. SPALDING, Mayor,
J. W. HAINES,
GEO. A. FISHER,
C. F. BUCKMAN,
40-2t Fire and Water Committee.

For Other Proposals See P. XVI

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NEW YORK & BERMUDEZ COMPANY,

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Sanitary District of Chicago.

TO CONTRACTORS.

"Proposals for supplying and erecting certain swing or draw bridges and fixed spans along the line of the Main Drainage Channel" will be received by the Clerk of the said Sanitary District at Room H, Rialto Building, Chicago, Ill., until 12 m. (standard time) of Wednesday, the 1st day of October, A. D 1894, and will be publicly opened by said Board of Trustees at the regular meeting held that day, or at a special meeting held for that purpose.

The bridges for which the said tenders are invited are three in number, and their sites are as follows: Romeo, near the west end of Contract Section No. 12 of the Main Drainage Channel; Lemont, near the center of Contract Section No. 8 of the said channel; and Willow Springs, near the east end of Contract Section No. 1 of the Main Drainage Channel.

Each of said bridges will be treated as a separate contract in canvassing proposals and making awards. As the awards will be of each bridge separately, each bidder must make prices for each bridge separately and distinctly from every other.

Each proposal for each bridge shall be accompanied by strain sheet, etc., as provided in the specifications, and by a certified check or cash to the amount of $1,000. All checks to be drawn on some responsible bank doing business in the city of Chicago and made payable to the Clerk of the Sanitary District of Chicago. Said amount of $1,000 to accompany each bid for each of the respective bridges will be held by the Sanitary District until all of said proposals have been canvassed and contracts awarded and signed. The return of said check or cash to the bidder to whom said work shall have been awarded being conditioned upon his appearing within 10 days after notice of such award being given, with bondsmen, and executing a contract with the Sanitary District for the work so awarded and giving a bond satisfactory to the Board of Trustees for the fulfillment of the same in the amount of $10,000 for each bridge which shall have been awarded to him.

All proposals must be made upon blank forms furnished by the Sanitary District and must give the price for each separate item of the work as provided in said forms. The bids will be compared in accordance with the terms of the specifications.

No proposal will be considered unless the party making it shall furnish evidence satisfactory to the Board of Trustees of his ability to do the work, and that he has the necessary pecuniary resources to fulfill the conditions of the contract, provided such contract shall be awarded to him.

Bidders are required to state in their proposals their individual names and places of residence in full.

Specifications and plans may be seen at the office of the Chief Engineer, Rialto Building Chicago, Ill.

The Board of Trustees reserves the right to reject any and all bids.

THE SANITARY DISTRICT OF CHICAGO,
By FRANK WENTER,
President of its Board of Trustees.

Attest:
THOS. F. JUDGE, Clerk.
CHICAGO, Ill., Aug. 29, 1894. 36-4teow

Sanitary District of Chicago.

TO CONTRACTORS.

"Proposals for supplying and erecting certain bridge masonry along the line of the Main Drainage Channel" will be received by the Clerk of the said Sanitary District at Room H, Rialto Building, Chicago, Illinois, until 12 m. (standard time) of Wednesday, the 31st day of October, A. D. 1894, and will be publicly opened by said Board of Trustees at the regular meeting held that day, or at a special meeting held for that purpose.

The bridges for which the said tenders are invited are three in number and their sites are as follows: Romeo, near the west end of Contract Section No. 12 of the Main Drainage Channel; Lemont, near the center of Contract Section No. 8 of the said Channel; and Willow Springs, near the east end of Contract Section No. 1 of the Main Drainage Channel.

All of said bridges will be treated as a single contract in canvassing proposals and making awards.

Each proposal shall be accompanied by a certified check or cash to the amount of $1,000 All checks to be drawn on some responsible bank doing business in the City of Chicago, and made payable to the Clerk of the Sanitary District of Chicago. Said amount of $1,000 to accompany each bid will be held by the Sanitary District until all of said proposals have been canvassed and contracts awarded and signed. The return of said check or cash to the bidder to whom said work shall have been awarded being conditioned upon his appearing within seven days after notice of such award being given, with bondsmen, and executing a contract with the Sanitary District for said work so awarded and giving a bond satisfactory to the Board of Trustees for the fulfillment of the same in the amount of $5,000.

All proposals must be made upon blank forms furnished by the Sanitary District, and must give the price for each separate item of the work as provided in said forms. The bids will be compared in accordance with the terms of the specification.

No proposal will be considered unless the party making it shall furnish evidence satisfactory to the Board of Trustees of his ability to do the work and that he has the necessary pecuniary resources to fulfill the conditions of the contract, provided such contract shall be awarded him.

Bidders are required to state in their proposals their individual names and places of residence in full.

Specifications and plans may be seen at the office of the Chief Engineer, Rialto Building, Chicago, Ill.

The Board of Trustees reserves the right to reject any and all bids.

THE SANITARY DISTRICT OF CHICAGO,
By FRANK WENTER,
President of its Board of Trustees.

Attest:
THOMAS F. JUDGE, Clerk.
Chicago, Ill., Aug. 29, 1894. 36-4teow

SEALED PROPOSALS

Will be received by the Building Committee of Beaver Falls, Pa., Council, until 3 o'clock p. m. of Tuesday, October 16th, for two 3,000,000 gallon pumps, and for the building of a 6,000,000 gallon reservoir.

Also, at 3 p. m. of November 6th, a complete filtering plant, with a capacity of 3,000,000 gallons in 24 hours, and buildings to contain the pumps, boilers and filtering plant.

Plans may be seen and detail specifications for the above-mentioned work and material can be obtained of the Borough Clerk, W. W. Kerr, and also at the office of the engineers, James H. Harlow & Co., Times Building, Pittsburg, Pa., and Wilkinsburg, Pa., two weeks previous to the above dates.

At the time and dates above mentioned the several proposals will be received and publicly opened and read. A certified check will be required of bidders for 2½% of bid.

The right is reserved to reject any or all bids.

SAMUEL CREESE, Chairman;
H. F. DILLON,
L. S. LUTTON,
A. O. MEYERS,
40-2t TITUS WELSH,
Building Committee.
JAMES H. HARLOW & CO., Engineers.

DRAINAGE.

Proposals for improvement, Sawmill River, Westchester County, N. Y., about 5¼ miles, and draining adjacent marsh lands, appear in Mount Vernon (N. Y.) "Record" and Mt. Kisco (N. Y.) "Recorder." Bids open Oct. 27, 1894.

JOHN F. FAIRCHILD,
Engineer to Commission,
Bank Building, Mount Vernon, N. Y.
40-2t

PROPOSALS FOR FURNISHING SEWER PIPE AND INVERT BLOCKS.

Office of the Commissioners,
Washington, D. C., Sept. 29, 1894.

Sealed proposals will be received at this office until 2 P. M., Oct. 13, 1894, for furnishing and delivering sewer pipe and invert blocks. Specifications and blank forms of proposals may be obtained at this office. J. W. Ross, George Truesdell, C. F. Powell, Commissioners D. C. 39-2t

U. S. ENGINEER OFFICE, 366 Milwaukee St., Milwaukee, Wis., Oct. 1, 1894.—Sealed proposals for: Green Bay Harbor, Wis., dredging 200,000 cubic yards; Kewaunee Harbor, Wis., pile pier extension 325 feet; Manitowoc Harbor, Wis., construction of breakwater 400 feet; Sheboygan Harbor, Wis., pile pier construction 900 feet; will be received here until 12 o'clock noon, Nov. 1, 1894, and then publicly opened. All information furnished on application. JAMES F. GREGORY, Major Engineers. 40-4t

U. S. ENGINEER OFFICE, 366 Milwaukee Street, Milwaukee, Wis., October 1, 1894.—Sealed Proposals for: Harbor of Refuge, Milwaukee, Wis., extending breakwater, 300 feet; Racine Harbor, Wis., pier extension, 150 feet; Kenosha Harbor, Wis., pier extension, 150 feet; Waukegan Harbor, Ill., pile pier extension, 240 feet—will be received here until 12 o'clock, noon, November 6th, 1894, and then publicly opened. All information furnished on application. JAMES F. GREGORY, Major Engrs. 40-4t

TREASURY DEPARTMENT, Office Supervising Architect, Washington, D. C., Sept 25, 1894.—Sealed proposals will be received at this office until 2 o'clock p. m. on the 24th day of October, 1894, and opened immediately thereafter, for removing the old steam-heating apparatus and to furnish all the labor and materials and fix in place complete the low-pressure, return-circulation, steam-heating and ventilating apparatus for the U. S. Custom House and Post Office Building at New Haven, Conn., in accordance with the drawings and specification, copies of which may be had at this office, or the office of the custodian at New Haven, Conn. Each bid must be accompanied by a certified check for a sum not less than 2 per cent. of the amount of the proposal. The right is reserved to reject any or all bids and to waive any defect or informality in any bid, if it be deemed in the interest of the Government to do so. All proposals received after the time stated will be returned to the bidders. Proposals must be inclosed in envelopes, sealed and marked "Proposal for Removing Old and Constructing New Heating and Ventilating Apparatus for the U. S. Custom House and Post Office Building at New Haven, Conn.," and addressed to CHARLES E. KEMPER, Acting Supervising Architect. 39-2t

TREASURY DEPARTMENT, Office Supervising Architect, Washington, D. C., September 25, 1894.—Sealed proposals will be received at this office until 2 o'clock P. M. on the 23d day of October, 1894, and opened immediately thereafter, for all the labor and materials required for the approaches, etc., for the U. S. Court House and Post Office at Detroit, Mich., including all the stone and brickwork required for the Wayne and Shelby Street entrances in accordance with drawings and specification, copies of which may be had at this office or the office of the Superintendent at Detroit, Mich. Each bid must be accompanied by a certified check for a sum not less than 2 per cent. of the amount of the proposal. The right is reserved to reject any or all bids, and to waive any defect or informality in any bid, should it be deemed in the interest of the Government to do so. All bids received after the time stated will be returned to the bidders. Proposals must be inclosed in envelopes, sealed and marked "Proposal for Approaches, Etc., for the U. S. Court House and Post Office at Detroit, Michigan," and addressed to CHARLES V. KEMPER, Acting Supervising Architect. 39-2t

U. S. ENGINEER OFFICE, ROOM H 7, 39 Whitehall St., New York City, Sept. 24, 1894.—Sealed proposals for construction of breakwaters at Duck Island Harbor, New Haven Harbor, mouth of Housatonic River, Conn., and Glen Cove Harbor, N. Y., will be received here until 12 o'clock noon, Tuesday, Oct. 16, 1894, and then publicly opened. All information furnished on application. HENRY M. ROBERT, Lieut.-Col. Engrs. 39-3t

U. S. ENGINEER OFFICE, ST. AUGUSTINE, Fla., Sept. 25, 1894.—Sealed proposals, in duplicate, will be received at this office until 12 o'clock noon, Oct. 25, 1894, and then publicly opened, for delivering 10,000 tons, more or less, of granite or other hard and durable rock upon the jetty at the northwest entrance to Key West Harbor, Fla. All information will be furnished on application to this office. THOS. H. HANDBURY, Major Corps of Engrs, U. S. A. 39-4t

U. S. ENGINEER OFFICE, NORFOLK, Va., Sept. 11, 1894.—Sealed proposals for dredging in harbor at Norfolk, and its approaches, Virginia, will be received at this office until 12 o'clock, noon, Oct. 11, 1894, and then publicly opened. All information will be furnished on application to this office. EDWARD BURR, First Lieut. Corps of Engineers, U. S. A. 37-4t

U. S. ENGINEER OFFICE, NORFOLK, Va., Sept. 11, 1894.—Sealed proposals for dredging in Nansemond River, Va., will be received at this office until 12 o'clock noon, Oct. 11, 1894, and then publicly opened. All information will be furnished on application to this office. EDWARD BURR, First Lieut. Corps of Engineers, U. S. A. 37-4t

U. S. ENGINEER OFFICE, 601 EIGHTEENTH Street, N. W., Washington, D. C., Sept. 17, 1894.—Sealed proposals for dredging in Occoquan and Aquia Creeks, Va., will be received here until 12 M., Wednesday Oct. 17, 1894, and then publicly opened All information furnished on application. CHAS. E. L. B. Davis, Major Engrs. 38-4t

PROPOSALS FOR MODEL BARGES, U. S. Engineer Office, Room 430, Custom House, St. Louis, Mo., Sept. 24, 1894.—Sealed proposals, in duplicate, for furnishing 12 model barges will be received here until 12 M., Oct. 24, 1894, and then publicly opened. All information furnished on application. CHAS. J. ALLEN, Major Engrs. 39-3t

U. S. ENGINEER OFFICE, ARMY BUILDing, New York, Sept. 13, 1894.—Sealed proposals for dredging channels in Raritan Bay, N. J., will be received here until 12 m., Oct. 15, 1894, and then publicly opened. All information furnished on application. ROBERT McGREGOR. Second Lieut. Engrs. 39-3t

U. S. ENGINEER OFFICE, BOSTON, Mass., Sept. 22, 1894.—Sealed proposals for Removal of Ledges from Boston Harbor, Mass., will be received here until noon Oct. 22, 1894, and then publicly opened. All information furnished on application. S. M. MANSFIELD, Lieut.-Col. Engrs. 39-3t

U. S. ENGINEER OFFICE, ROOM H 7, 39 Whitehall St., New York City, Sept. 24, 1894.—Sealed proposals for dredging in Mystic River, New Haven Harbor, Bridgeport Harbor, Norwalk Harbor, Conn., and East Chester Creek, N. Y., will be received here until 12 o'clock noon, Tuesday, Oct. 16, 1894, and then publicly opened. All information furnished on application. HENRY M. ROBERT, Lieut.-Col. Engrs. 39-3t

U. S. ENGINEER OFFICE, 121 Franklin St., Buffalo, N. Y., Sept. 14, 1894.—Sealed proposals will be received at this office until 2 p. m., Oct. 15, 1894, and then publicly opened for the hire of dredging plant; including a submarine drill boat; for use on the Niagara River, between Tonawanda and Port Day. For information apply to Major E. H. RUFFNER, Corps of Engineers. 38-3t

U. S. ENGINEER OFFICE, ARMY BUILding, New York, Sept. 10, 1894.—Sealed proposals for dredging Red Hook Shoal, in Buttermilk Channel, New York, will be received here until 12 M., Oct. 11, 1894, and then publicly opened. All information will be furnished on application. ROBERT McGREGOR, 2d Lieut., Corps of Engrs. 38-4t

U. S. ENGINEER OFFICE, 9 PLEASANT Street, Baltimore, Md., Sept. 11, 1894.—Sealed proposals for dredging in the Ship Channel leading to the harbor of Baltimore will be received until noon of October 11, 1894, and then opened. For information apply to WILLIAM P. CRAIGHILL, Colonel Corps of Engineers, U. S. A. 38-3t

U. S. ENGINEER OFFICE, 601 EIGHTeenth street N. W., Washington, D. C., Sept. 17, 1894.—Sealed proposals for furnishing riprap stone at Occoquan Creek, Va., will be received here until 12 M. Wednesday, October 17, 1894, and then publicly opened All information furnished on application. CHAS. E. L. B. DAVIS, Major Engineers. 38-4t

U. S. ENGINEER OFFICE, 537 CONGRESS street, Portland, Me., Sept. 14, 1894.—Sealed proposals for dredging in Back Cove, Portland Harbor, Me., will be received here until 3 P. M., Monday, Oct. 15, 1894, and then publicly opened. All information furnished on application to PETER C. HAINS, Lieut. Col. Engrs. 39-3t

IMPROVEMENT OF DELAWARE RIVER.—U. S. Engineer Office, 1428 Arch Street, Philadelphia, Pa., October 3, 1894.—Sealed proposals for dredging in the channel through Bulkhead Bar, Delaware River, will be received here until 11 a.m., November 2d, 1894, and then publicly opened. All information furnished on application. C. W. RAYMOND, Major Engrs. 40-4t

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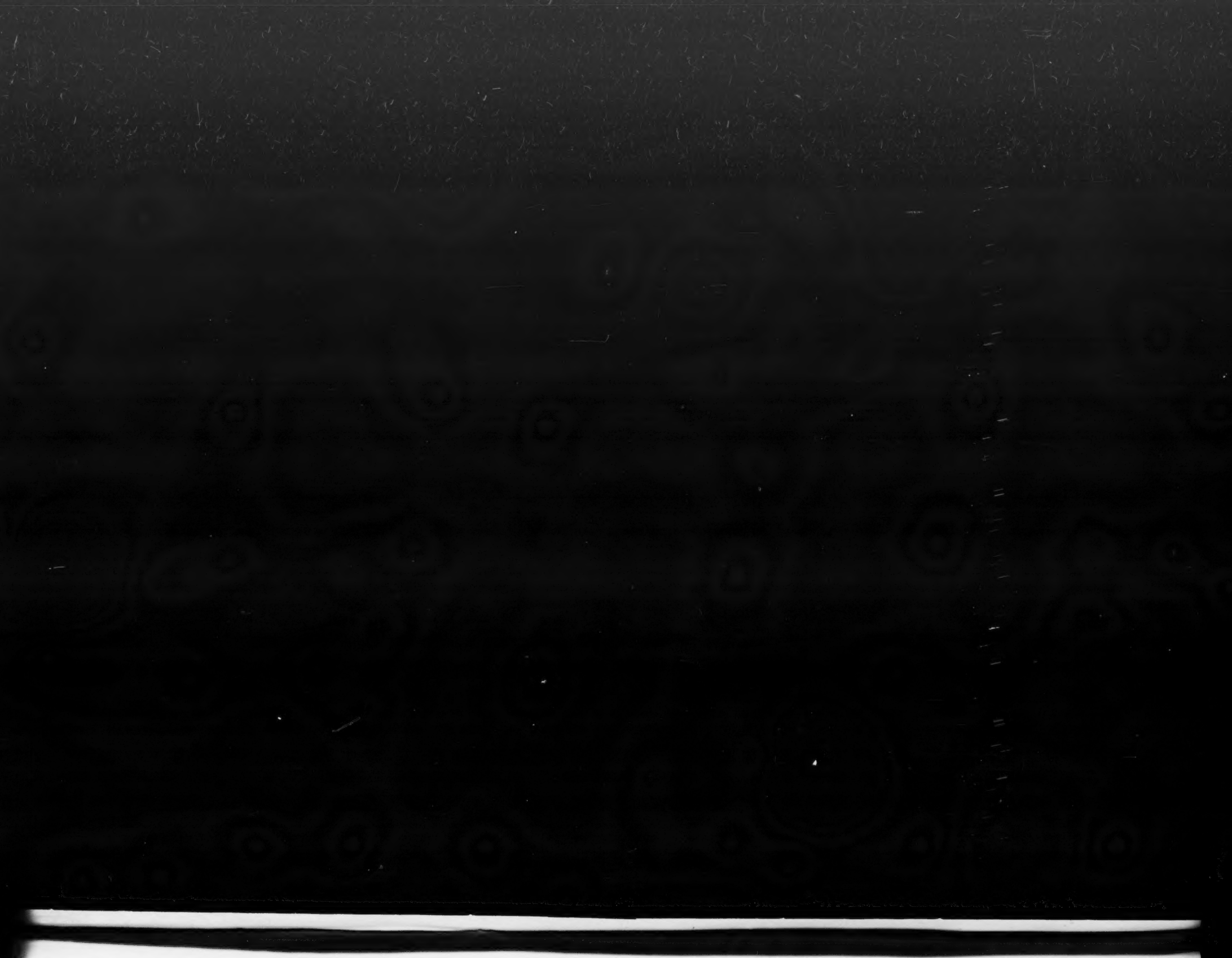
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